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Johansson et al.

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(54) **DEVICE CHARGING SYSTEM**

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(73) Assignee: **Amazon Technologies, Inc.**, Reno, NV (US)

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(51) **Int. Cl.**

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G06F 1/28	(2006.01)
H02J 7/00	(2006.01)
G06F 1/32	(2006.01)
G06F 1/16	(2006.01)
H02J 7/04	(2006.01)

(52) **U.S. Cl.**
CPC ***G06F 1/28*** (2013.01); *G06F 1/1616* (2013.01); *G06F 1/26* (2013.01); *G06F 1/3212* (2013.01); *H02J 7/0054* (2013.01); *H02J 7/0073* (2013.01); *H02J 7/041* (2013.01)

(58) **Field of Classification Search**
CPC G06F 1/26; G06F 1/28; G06F 1/3212; H02J 7/0021; H02J 7/0054; H02J 2007/0049; H02J 2007/005
USPC 713/300, 330, 340
See application file for complete search history.

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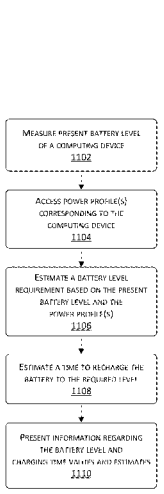
Primary Examiner — Michael J Brown
(74) *Attorney, Agent, or Firm* — Lindauer Law, PLLC

(57) **ABSTRACT**

A computing device monitors the energy level of a rechargeable battery, from which the device draws operating power. Historic usage data is used to estimate the time remaining in a present operating period, such as a workday, as well as to estimate the battery level required to provide power during that period of time. A user is then presented with information regarding the status of the battery, as well as charging time and required battery level estimates. Information regarding charging stations within publically or otherwise user-accessible venues near to the present location of the computing device is accessed and presented to the user. Reservations may be made for a charging port within a selected venue, an order may be placed for goods or services available at that venue, or other actions may be performed.

20 Claims, 12 Drawing Sheets



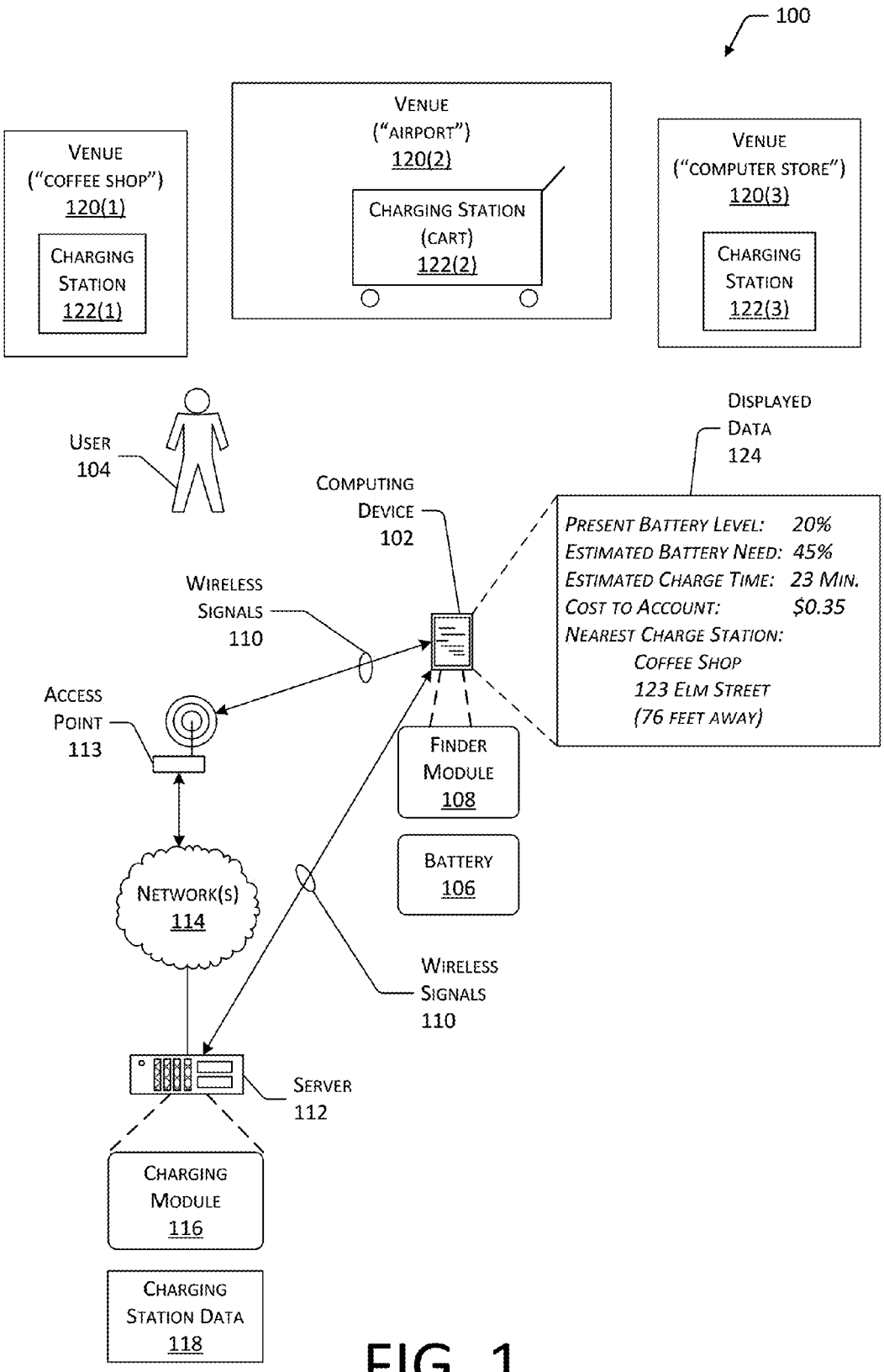
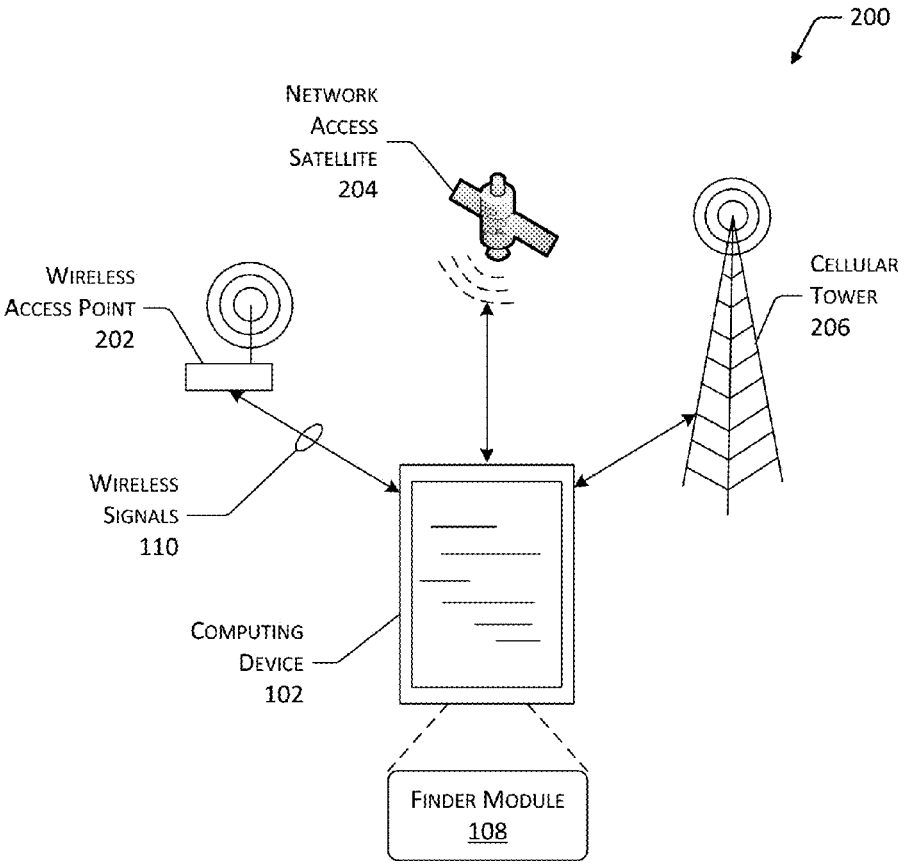

100
VENUE ("COFFEE SHOP") 120(1)
CHARGING STATION 122(1)
VENUE ("AIRPORT") 120(2)
CHARGING STATION (CART) 122(2)
VENUE ("COMPUTER STORE") 120(3)
CHARGING STATION 122(3)
USER 104
COMPUTING DEVICE 102
DISPLAYED DATA 124
PRESENT BATTERY LEVEL: 20%
ESTIMATED BATTERY NEED: 45%
ESTIMATED CHARGE TIME: 23 MIN.
COST TO ACCOUNT: $0.35
NEAREST CHARGE STATION:
COFFEE SHOP
123 ELM STREET
(76 FEET AWAY)
WIRELESS SIGNALS 110
ACCESS POINT 113
FINDER MODULE 108
BATTERY 106
NETWORK(S) 114
WIRELESS SIGNALS 110
SERVER 112
CHARGING MODULE 116
CHARGING STATION DATA 118

FIG. 1



Charging Station Data 118

Venue 120	Location 208	Total Ports 210	Available 212	Reservations 214	Access 216	Power Param. 218
Coffee Shop	123 Elm Street	6	2	Yes: Hold for 15 Min	Public	5V, 2A
Computer Store	362 Elm Street	6	1	No	Club Only	5V, 12V 2A, 3A
Airport	Charge Cart Gate B-15	16	N/A	N/A	Public	5V, 2A

FIG. 2

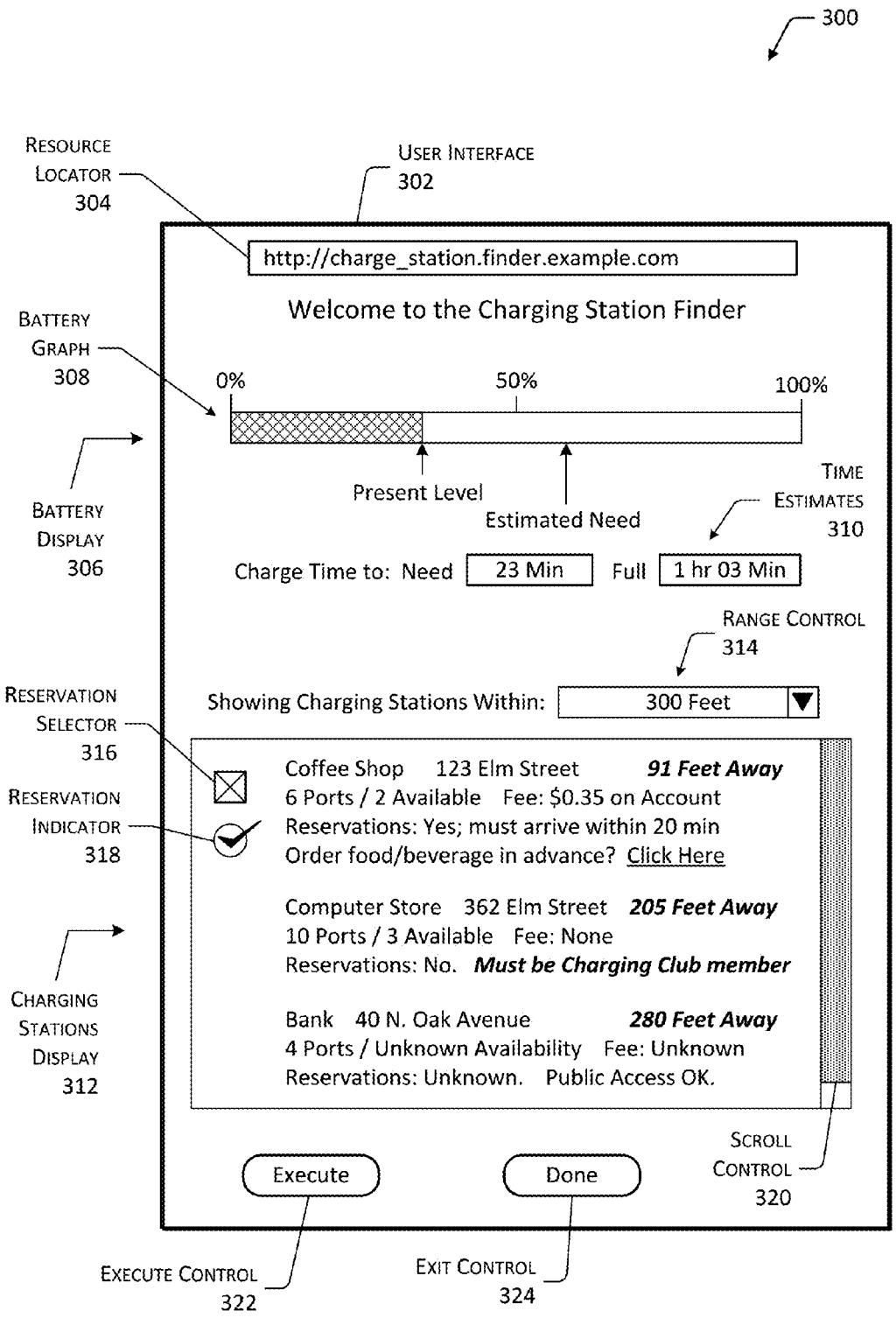

300
Resource Locator 304
User Interface 302
http://charge_station.finder.example.com
Welcome to the Charging Station Finder
Battery Graph 308
0%
50%
100%
Present Level
Estimated Need
Time Estimates 310
Battery Display 306
Charge Time to: Need
23 Min
Full
1 hr 03 Min
Range Control 314
Showing Charging Stations Within:
300 Feet
Reservation Selector 316
Reservation Indicator 318
Coffee Shop 123 Elm Street 91 Feet Away
6 Ports / 2 Available Fee: $0.35 on Account
Reservations: Yes; must arrive within 20 min
Order food/beverage in advance? Click Here
Computer Store 362 Elm Street 205 Feet Away
10 Ports / 3 Available Fee: None
Reservations: No. Must be Charging Club member
Bank 40 N. Oak Avenue 280 Feet Away
4 Ports / Unknown Availability Fee: Unknown
Reservations: Unknown. Public Access OK.
Charging Stations Display 312
Scroll Control 320
Execute
Done
Execute Control 322
Exit Control 324

FIG. 3

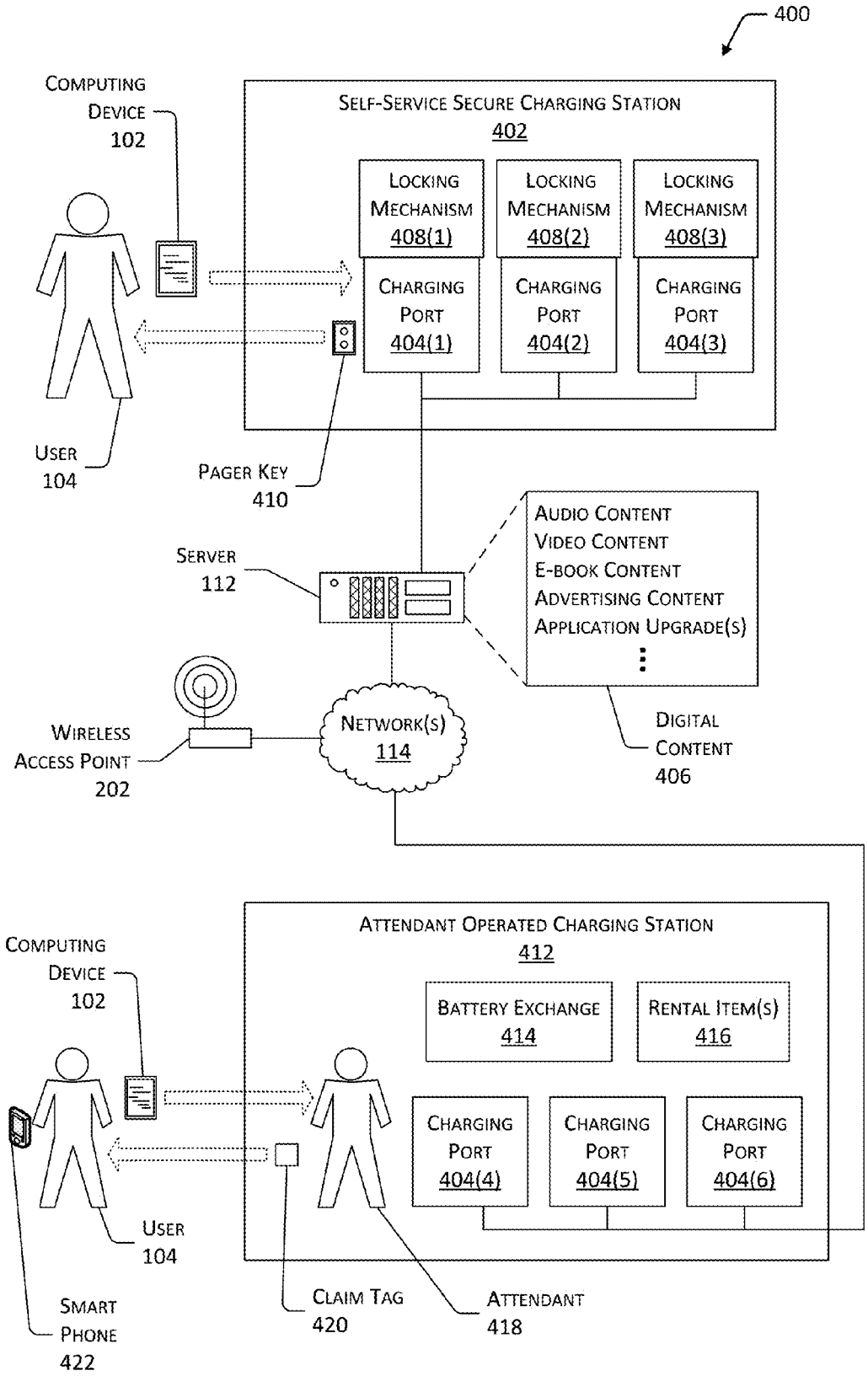

400
COMPUTING DEVICE 102
SELF-SERVICE SECURE CHARGING STATION 402
LOCKING MECHANISM 408(1)
LOCKING MECHANISM 408(2)
LOCKING MECHANISM 408(3)
CHARGING PORT 404(1)
CHARGING PORT 404(2)
CHARGING PORT 404(3)
USER 104
PAGER KEY 410
SERVER 112
AUDIO CONTENT
VIDEO CONTENT
E-BOOK CONTENT
ADVERTISING CONTENT
APPLICATION UPGRADE(S)
WIRELESS ACCESS POINT 202
NETWORK(S) 114
DIGITAL CONTENT 406
ATTENDANT OPERATED CHARGING STATION 412
COMPUTING DEVICE 102
BATTERY EXCHANGE 414
RENTAL ITEM(S) 416
CHARGING PORT 404(4)
CHARGING PORT 404(5)
CHARGING PORT 404(6)
USER 104
SMART PHONE 422
CLAIM TAG 420
ATTENDANT 418

FIG. 4

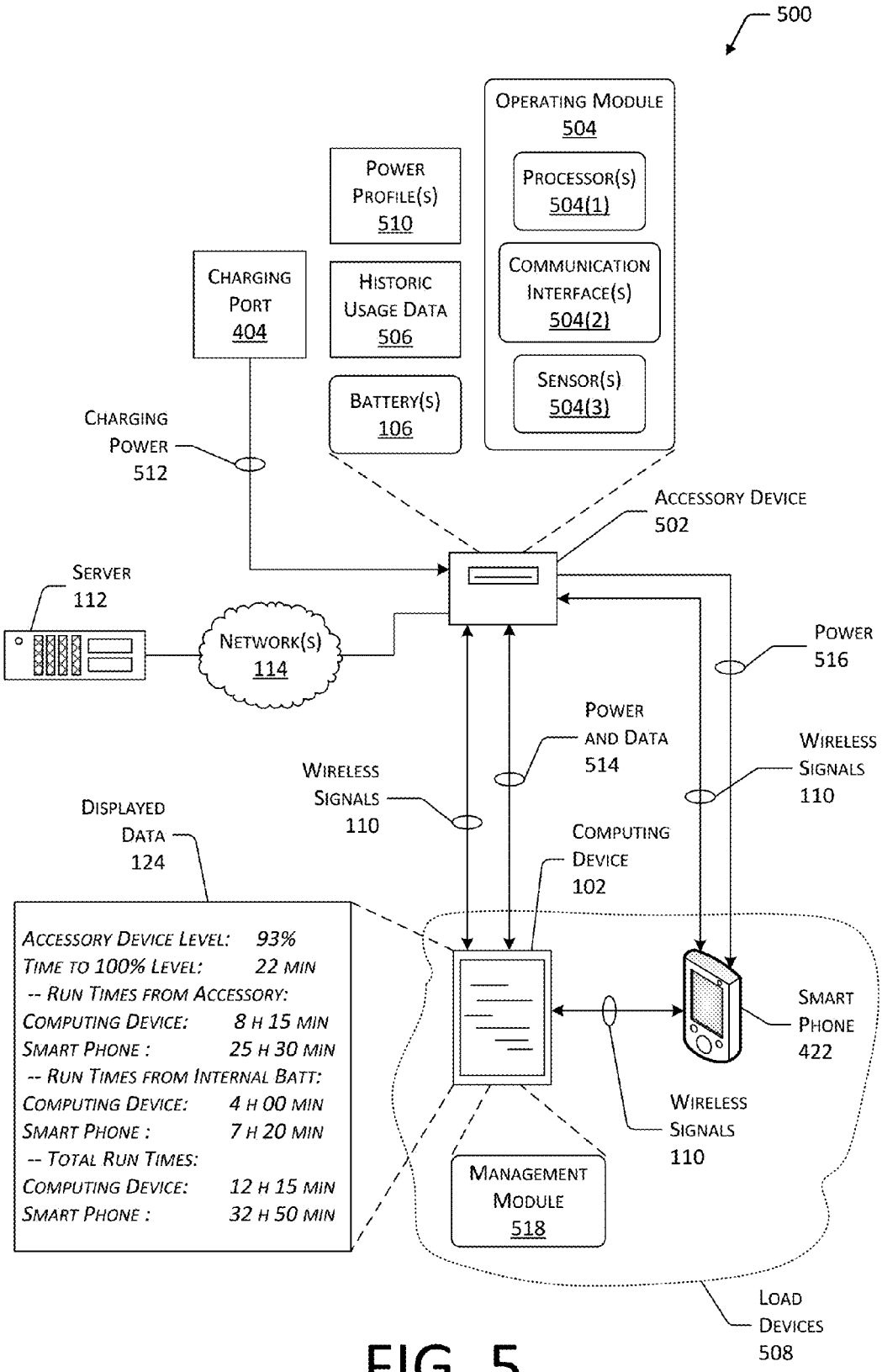

500
Operating Module
504
Processor(s)
504(1)
Communication Interface(s)
504(2)
Sensor(s)
504(3)
Power Profile(s)
510
Historic Usage Data
506
Battery(s)
106
Charging Port
404
Charging Power
512
Accessory Device
502
Server
112
Network(s)
114
Power
516
Power and Data
514
Wireless Signals
110
Wireless Signals
110
Displayed Data
124
Computing Device
102
Accessory Device Level: 93%
Time to 100% Level: 22 min
-- Run Times from Accessory:
Computing Device: 8 h 15 min
Smart Phone : 25 h 30 min
-- Run Times from Internal Batt:
Computing Device: 4 h 00 min
Smart Phone : 7 h 20 min
-- Total Run Times:
Computing Device: 12 h 15 min
Smart Phone : 32 h 50 min
Smart Phone
422
Wireless Signals
110
Management Module
518
Load Devices
508

FIG. 5

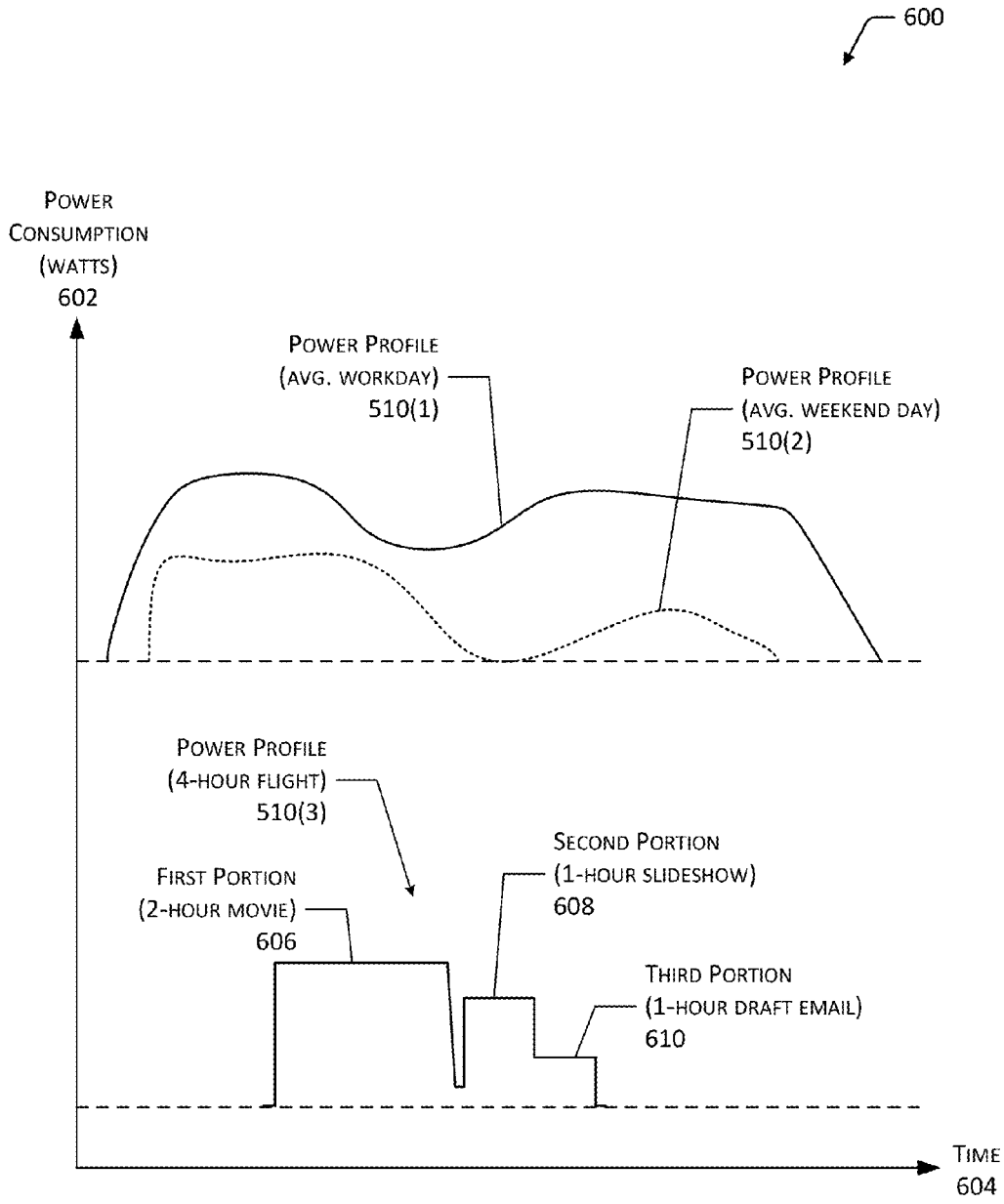

600
POWER CONSUMPTION (WATTS) 602
POWER PROFILE (AVG. WORKDAY) 510(1)
POWER PROFILE (AVG. WEEKEND DAY) 510(2)
POWER PROFILE (4-HOUR FLIGHT) 510(3)
FIRST PORTION (2-HOUR MOVIE) 606
SECOND PORTION (1-HOUR SLIDESHOW) 608
THIRD PORTION (1-HOUR DRAFT EMAIL) 610
TIME 604

FIG. 6

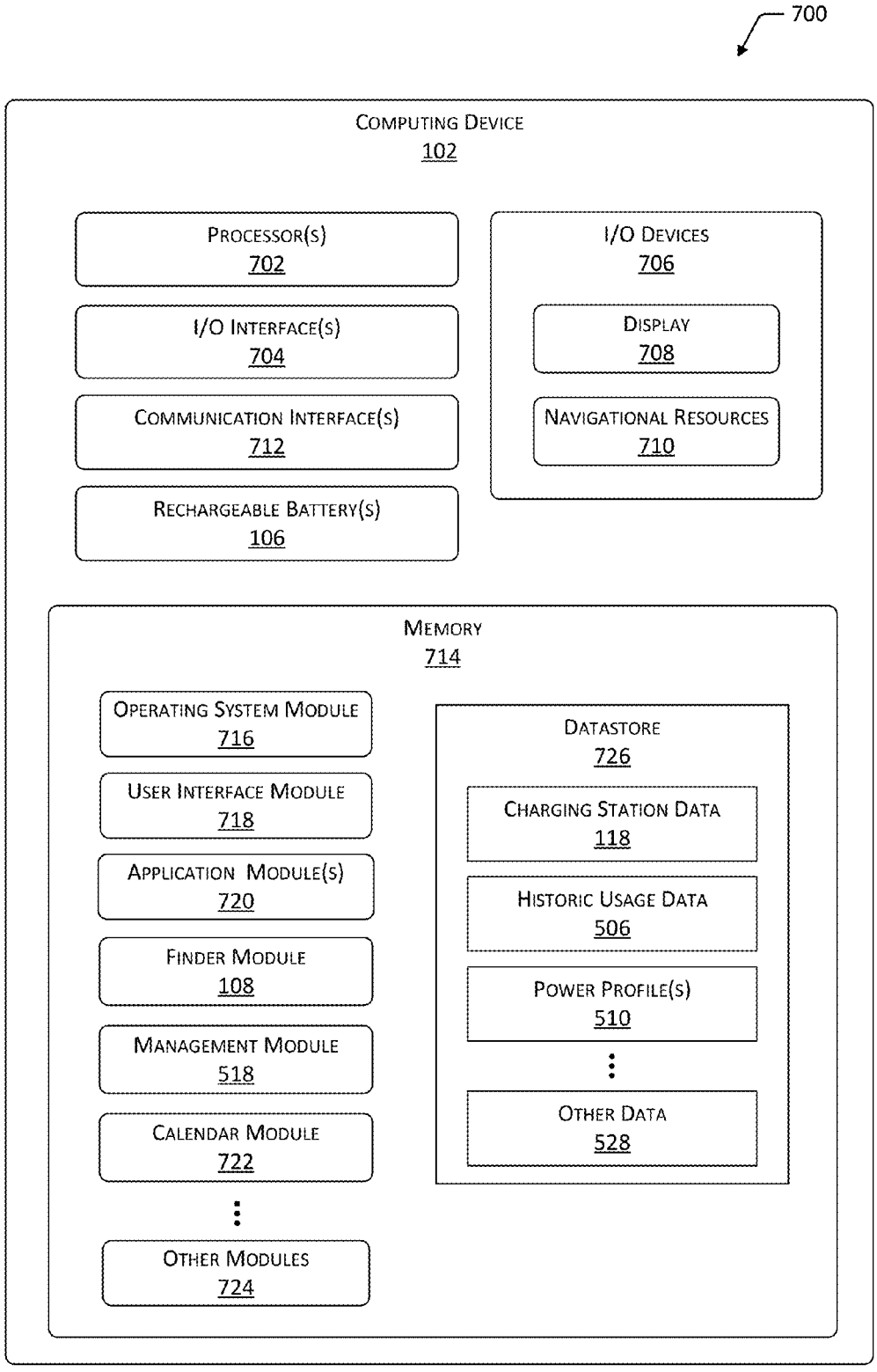

700
COMPUTING DEVICE
102
PROCESSOR(S)
702
I/O INTERFACE(S)
704
COMMUNICATION INTERFACE(S)
712
RECHARGEABLE BATTERY(S)
106
I/O DEVICES
706
DISPLAY
708
NAVIGATIONAL RESOURCES
710
MEMORY
714
OPERATING SYSTEM MODULE
716
USER INTERFACE MODULE
718
APPLICATION MODULE(S)
720
FINDER MODULE
108
MANAGEMENT MODULE
518
CALENDAR MODULE
722
OTHER MODULES
724
DATASTORE
726
CHARGING STATION DATA
118
HISTORIC USAGE DATA
506
POWER PROFILE(S)
510
OTHER DATA
528

FIG. 7

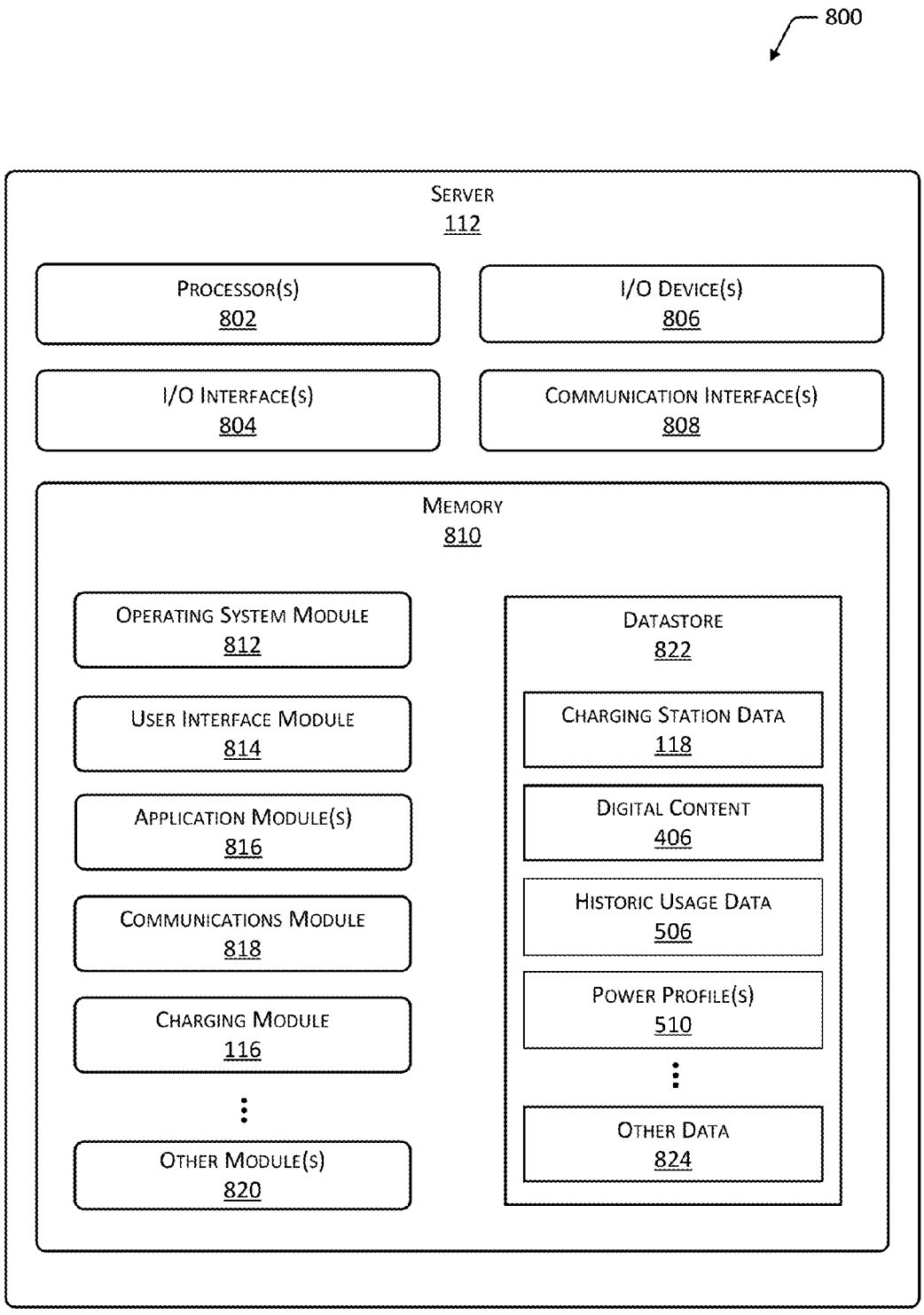

800
SERVER
112
PROCESSOR(S)
802
I/O DEVICE(S)
806
I/O INTERFACE(S)
804
COMMUNICATION INTERFACE(S)
808
MEMORY
810
OPERATING SYSTEM MODULE
812
USER INTERFACE MODULE
814
APPLICATION MODULE(S)
816
COMMUNICATIONS MODULE
818
CHARGING MODULE
116
OTHER MODULE(S)
820
DATASTORE
822
CHARGING STATION DATA
118
DIGITAL CONTENT
406
HISTORIC USAGE DATA
506
POWER PROFILE(S)
510
OTHER DATA
824

FIG. 8

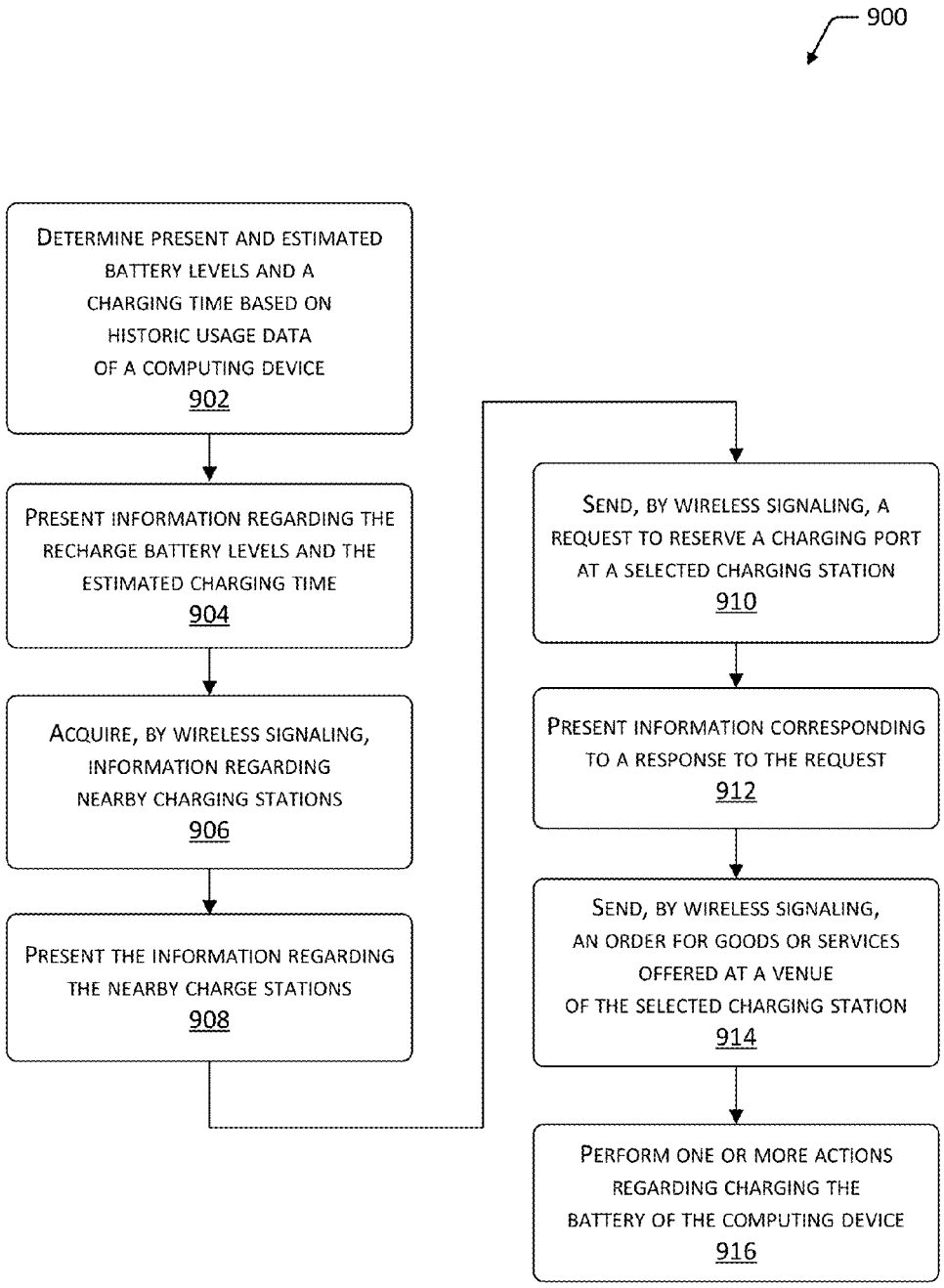

900
DETERMINE PRESENT AND ESTIMATED BATTERY LEVELS AND A CHARGING TIME BASED ON HISTORIC USAGE DATA OF A COMPUTING DEVICE
902
PRESENT INFORMATION REGARDING THE RECHARGE BATTERY LEVELS AND THE ESTIMATED CHARGING TIME
904
ACQUIRE, BY WIRELESS SIGNALING, INFORMATION REGARDING NEARBY CHARGING STATIONS
906
PRESENT THE INFORMATION REGARDING THE NEARBY CHARGE STATIONS
908
SEND, BY WIRELESS SIGNALING, A REQUEST TO RESERVE A CHARGING PORT AT A SELECTED CHARGING STATION
910
PRESENT INFORMATION CORRESPONDING TO A RESPONSE TO THE REQUEST
912
SEND, BY WIRELESS SIGNALING, AN ORDER FOR GOODS OR SERVICES OFFERED AT A VENUE OF THE SELECTED CHARGING STATION
914
PERFORM ONE OR MORE ACTIONS REGARDING CHARGING THE BATTERY OF THE COMPUTING DEVICE
916

FIG. 9

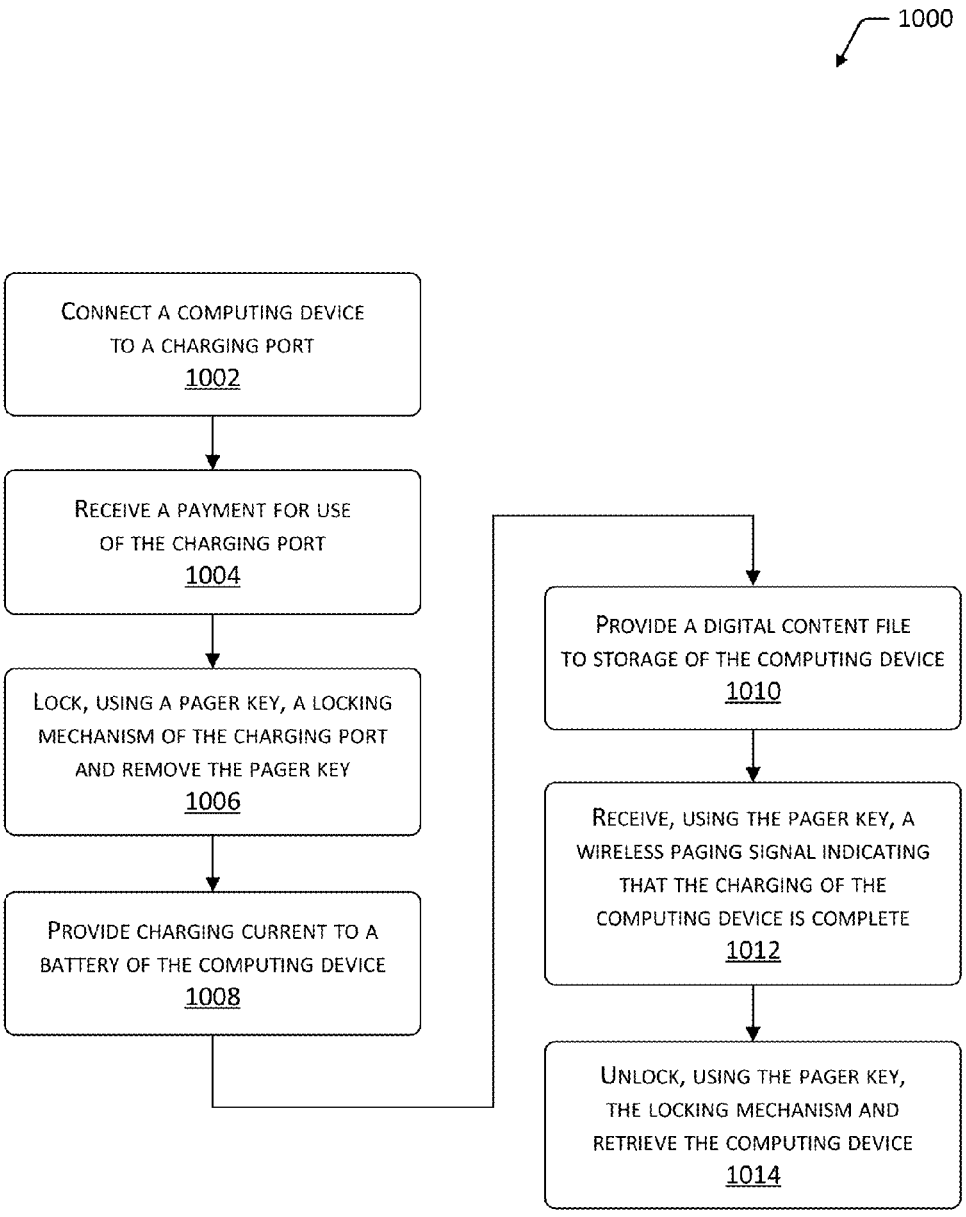

1000
CONNECT A COMPUTING DEVICE TO A CHARGING PORT
1002
RECEIVE A PAYMENT FOR USE OF THE CHARGING PORT
1004
LOCK, USING A PAGER KEY, A LOCKING MECHANISM OF THE CHARGING PORT AND REMOVE THE PAGER KEY
1006
PROVIDE CHARGING CURRENT TO A BATTERY OF THE COMPUTING DEVICE
1008
PROVIDE A DIGITAL CONTENT FILE TO STORAGE OF THE COMPUTING DEVICE
1010
RECEIVE, USING THE PAGER KEY, A WIRELESS PAGING SIGNAL INDICATING THAT THE CHARGING OF THE COMPUTING DEVICE IS COMPLETE
1012
UNLOCK, USING THE PAGER KEY, THE LOCKING MECHANISM AND RETRIEVE THE COMPUTING DEVICE
1014

FIG. 10

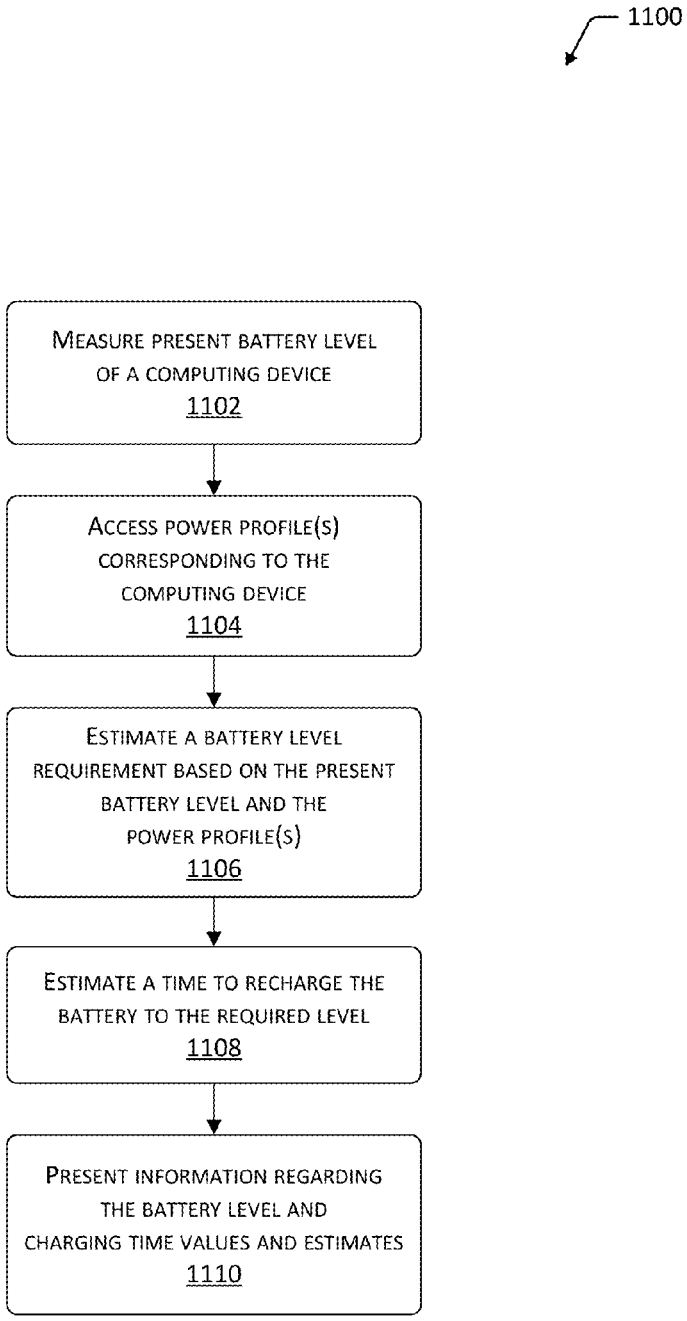

1100
MEASURE PRESENT BATTERY LEVEL OF A COMPUTING DEVICE
1102
ACCESS POWER PROFILE(S) CORRESPONDING TO THE COMPUTING DEVICE
1104
ESTIMATE A BATTERY LEVEL REQUIREMENT BASED ON THE PRESENT BATTERY LEVEL AND THE POWER PROFILE(S)
1106
ESTIMATE A TIME TO RECHARGE THE BATTERY TO THE REQUIRED LEVEL
1108
PRESENT INFORMATION REGARDING THE BATTERY LEVEL AND CHARGING TIME VALUES AND ESTIMATES
1110

FIG. 11

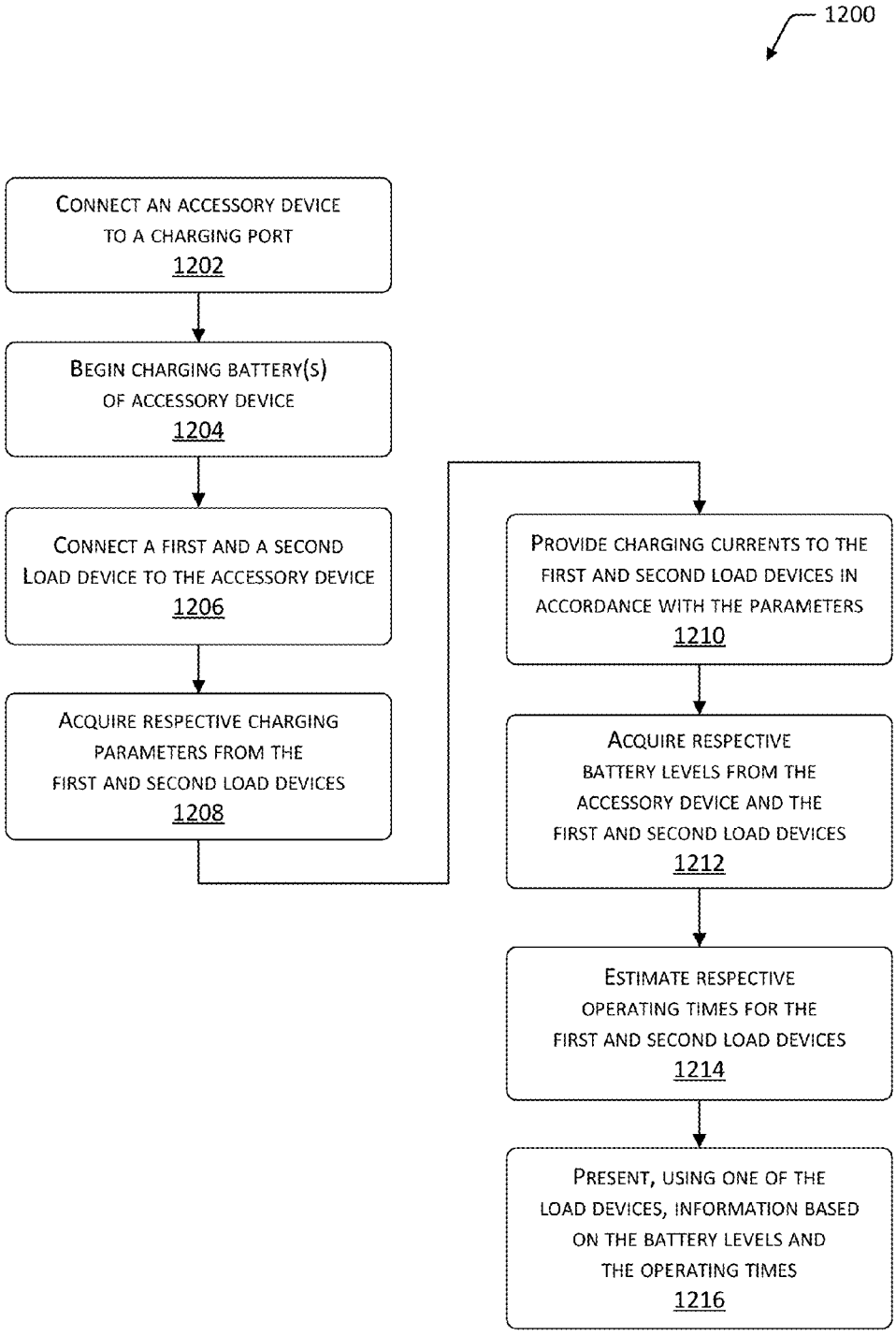

1200
CONNECT AN ACCESSORY DEVICE TO A CHARGING PORT
1202
BEGIN CHARGING BATTERY(S) OF ACCESSORY DEVICE
1204
CONNECT A FIRST AND A SECOND LOAD DEVICE TO THE ACCESSORY DEVICE
1206
ACQUIRE RESPECTIVE CHARGING PARAMETERS FROM THE FIRST AND SECOND LOAD DEVICES
1208
PROVIDE CHARGING CURRENTS TO THE FIRST AND SECOND LOAD DEVICES IN ACCORDANCE WITH THE PARAMETERS
1210
ACQUIRE RESPECTIVE BATTERY LEVELS FROM THE ACCESSORY DEVICE AND THE FIRST AND SECOND LOAD DEVICES
1212
ESTIMATE RESPECTIVE OPERATING TIMES FOR THE FIRST AND SECOND LOAD DEVICES
1214
PRESENT, USING ONE OF THE LOAD DEVICES, INFORMATION BASED ON THE BATTERY LEVELS AND THE OPERATING TIMES
1216

FIG. 12

DEVICE CHARGING SYSTEM

BACKGROUND

Portable computing devices often operate by way of rechargeable batteries. Loss of operating time resulting from the need to recharge such batteries is a concern for numerous users.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** depicts views including a computing device and a server, venues that provide charging stations, and information regarding battery levels and times for recharging that battery.

FIG. **2** depicts various devices or systems that may communicate with a computing device by way of wireless signals, and illustrative charging station data.

FIG. **3** depicts a user interface including information regarding levels of a rechargeable battery, and information regarding charging stations near to a computing device.

FIG. **4** depicts a block diagram of a system including a self-service secure charging station and an attendant operated charging station.

FIG. **5** is a block diagram depicting a system including a charging accessory, and respective load devices electrically coupled to the accessory device.

FIG. **6** is a function diagram depicting respective power profiles corresponding to a computing device.

FIG. **7** is a block diagram depicting a computing device.

FIG. **8** is a block diagram depicting a server.

FIG. **9** is a flow diagram of an illustrative process including estimating battery levels and charging time, and providing information about nearby charging stations.

FIG. **10** is a flow diagram of an illustrative process including charging a computing device at a secure charging station.

FIG. **11** is a flow diagram of an illustrative process including determining and estimating respective battery levels, estimating a charging time, and presenting that information regarding those values.

FIG. **12** is a flow diagram of an illustrative process including charging an accessory device, and charging respective load devices using the accessory device.

Certain implementations and embodiments will now be described more fully below with reference to the accompanying figures, in which various aspects are shown. However, various aspects may be implemented in many different forms and should not be construed as limited to the implementations set forth herein. Like numbers refer to like elements throughout.

DETAILED DESCRIPTION

People use a wide variety of portable computing devices for a vast number of purposes. Tablet computers, smart phones, electronic book or "e-book" readers, media devices, wearable computers, laptop computers, and so forth, are a few non-limiting examples. Often, such a computing device is operated for some number of hours as part of a daily routine, and then connected so as to recharge a battery or batteries at night or during another inactive period.

Sometimes, a user operates a computing device for longer than a normal period of time, or such operations are intensified due to additional computational tasks, an increased volume of electronic communications, or other activities. The result may be insufficient power remaining in the rechargeable battery or batteries to get through the present workday or other situation, without taking time to recharge. This problem may be remedied if the required charging equipment and a source of electrical energy are at hand. However, a user may wind up with insufficient battery power while away from their home or office and the needed charging facilities. Such a circumstance may occur in a public place like a downtown area, airport or other transportation hub, while aboard an aircraft or mass transit vehicle, and so on.

Charging station access, as well as related items or services, are being increasingly offered in public or other venues owing to the popularity of such portable computing devices. Coffee shops, airports, transit terminals, public libraries, and the like, often offer the use of charging ports, cable assemblies, or other accessories, as well as access to electrical energy so as to charge a computing device. Numerous such venues may be located within relatively close proximity to each other, such that a user in need of charging a computing device may have more than one option to select from. Nonetheless, if a user has no knowledge of which nearby venues offer such charging facilities, and which do not, considerable time may be wasted searching in vain—time that the user may not have to spare under the present circumstances.

In one example, a user of a tablet computer is visiting an unfamiliar city during business travel. The user has four hours remaining in their workday, but the rechargeable battery within their tablet computer is at 15% of capacity—approximately enough energy for just over one hour of normal operation. An application running in the background on their tablet computer uses historical usage data to determine that about three more hours of battery life are likely to be required, in addition to the one hour that is presently in the battery. The application then accesses a predetermined network resource by way of wireless signals, requesting information regarding accessible charging stations within a convenient distance—such as five hundred feet—of the present location.

The tablet computer receives a response to the request, which includes information regarding three different venues that offer charging stations accessible to the user or to the general public. The information includes venue names, addresses or locating directions, and describes other goods or services offered by each. This information, along with data regarding the present status and an estimated charging time for the rechargeable battery, are presented to the user by way of a display or other output device. The application further determines a distance to each of the three venues, and presents that information as well. The user is now aware that they will likely lose productive operating time if the battery is not charged, at least to a projected level of 60%. The user then selects one of the three venues, which is about one hundred feet away, using the presented address information. A mapping or navigational aid application, or other resources, may also be employed. The user then locates the charging station within the selected venue and begins charging the rechargeable battery, with no appreciable time wasted searching for such a location.

In another example, a user is awaiting a connecting flight in an airport terminal, while reading a novel on an "e-book" reader. A data file for a calendar application on the e-book reader indicates that their flight is scheduled to depart in one hour, and is slated to be two hours long. However, an application running in the background senses that the rechargeable battery in the e-book reader is presently at an 8% level, with a depleted state expected in approximately

forty minutes under present use. The application further estimates twenty minutes of charging time, beginning now, will charge the battery to a sufficient level to allow the user to read from their novel during the scheduled flight.

The application then presents a message on the display of the e-book reader, indicating the present state of the battery and recommending twenty minutes of charging time to provide sufficient, estimated power for use during the flight. The application further queries the user if they would like information regarding charging stations located within the airport. The user provides input to the e-book indicating that such information is desirable. The application then accesses a publicly accessible server of the airport by way of wireless signaling, seeking information regarding charging stations.

The server determines from stored data that two charging stations are present within two hundred feet of the wireless access point used by the requesting e-book reader. The server then sends information regarding these two charging stations to the e-book reader, which may include nearby gate numbers, names of the venues hosting the respective charging stations, and so forth. Other information may also be included. This information is presented on the e-book display, and the user notes that the nearest one of two charging stations is an attendant-based venue located just two gates away. The information further indicates that the nearer venue charges one dollar for twenty minutes of charging services, which may be applied to the user's credit card or online debit account. The user then proceeds toward the nearer of the two venues.

After arriving at the charging station, the user is greeted by the attendant who takes possession of the e-book reader in exchange for an electronic paging device. The user then authorizes the charging fee and uses their credit card to pay the charges. The user then departs for a nearby coffee vendor while the attendant connects the e-book reader to a charging port and begins the twenty minute charging process. While connected to the charging port, a server device downloads promotional information about items and services available from the commercial entity operating the charging station venue. Once the charging process is complete, the user is alerted by the paging device to return to the charging station venue. The paging device is then exchanged for their e-book reader, which is now sufficiently charged for use during the impending flight. Respective variations on the foregoing may also be used in accordance with the methods, devices, and systems described herein.

FIG. **1** depicts views **100** including particular elements and operations performed by each. The views **100** are illustrative and non-limiting in nature, and other elements, devices, systems, or respective operations are also contemplated.

A computing device **102** is depicted as a tablet computer. Numerous other types of computing devices **102**, such as "smart phones", wearable computers, laptop computers, media devices, e-book readers, and so on, may also be used. The computing device **102** is associated with a user **104**. The computing device **102** is configured for portable operation and is powered by a rechargeable battery **106**, which is supported by the computing device **102**.

In another instance, the computing device **102** is powered by one or more fuel cells, super capacitors, or another suitable type of energy storage device. Such energy storage devices are thus "rechargeable" by way of electrical energy, chemical energy or chemical refill, hydrogen-based fuel, one or more fuel cell reactants, mechanical energy stored by way of a wind-up spring, flywheel, or another consumable resource that may be replenished by way of a suitable charging station.

The computing device **102** also includes a finder module **108**. The finder module **108** may include electronic circuitry, a controller, non-volatile storage media, executable program code, or any other suitable constituency. The finder module **108** is configured to perform various operations and functions as described herein. The finder module **108** is further configured to access other resources of the computing device **102** such as wireless communications resources, rechargeable battery **106** management circuitry, a display or other output device, cellular communications circuitry, and so forth. The computing device **102** is also configured to send and receive data, signals, or other information by way of wireless signals **110**. Such wireless signals **110** may include, without limitation, those in accordance with Institute of Electrical and Electronics (IEEE) standard 802.11, such as Bluetooth®, Wi-Fi®, or other protocols. Other suitable wireless signaling formats, protocols, or standards may also be used.

A server **112** may be configured to communicate with the computing device **102** using an access point (AP) **113**, by way of one or more networks **114**, using the wireless signals **110**, and so forth. For example, the computing device **102** may connect to the access point **113** which is connected to the network **114**, which in turn connects to the server **112**. In another example, the server **112** may include the AP **113** or equivalent components and may provide wireless connectivity to the computing device **102**. The network(s) **114** may include a local-area network (LAN), a wide-area network (WAN), the Internet or access thereto, and so forth. In one instance, the server **112** may be owned or operated by an entity, such as a commercial enterprise, which offers goods or services related to charging rechargeable batteries **106**, as used within respective computing devices **102**. In another instance, the server **112** may be owned or operated by an entity that provides data regarding charging stations and other items of interest to business travelers or other persons. The server **112** may be associated with other entity types, as well, such as an online retailer, travel agency, facilities operator, and so forth.

The server **112** includes a charging module **116**. The charging module **116** may include electronic circuitry, a controller or controllers, non-volatile storage media, executable program code, one or more data structures, or any other suitable constituency. The charging module **116** is configured to perform various operations and functions as described herein. In one instance, the charging module **116** is configured to provide a network resource that is accessible by the computing device **102** through the network(s) **114**. For instance, such a network resource may be a webpage or webpages hosted by the server **112**. The network resource may present, or enable access to, information regarding respective charging stations located within accessible venues. For instance, such venues may be publically accessible, or specifically accessible to the user **104** such as the user's place of employment, a club where the user **104** is member, and so on. Other venue information or selection methods may also be used.

The server **112** may also store charging station data **118** including, but not limited to, venue names, addresses, geolocation coordinates, available charging voltages, available charging capacities or amperages, supported connector or computing device types, usage fees or related costs, security or access requirements, numbers of charging ports, reservation information, goods or services offered by the hosting

venue, and so forth. Other data or information may also be included in the charging station data **118**. The charging station data **118** may be formatted or stored as one or more data structures, classified or sorted based on respective cities or other geographic regions, and so on.

Also depicted are three respective accessible venues **120**. Specifically, venues **120(1)**, **120(2)**, and **120(3)** are depicted. Each venue **120(1)**-**120(3)** may be an entity such as a retailer, commercial service provider, government office, public facility, and so on. For purposes of non-limiting illustration, the venue **120(1)** may be a coffee shop, the venue **120(2)** may be an airport, and the venue **120(3)** may be a computer store. Other suitable venues **120** may also be considered. The venues **120(1)**-**120(3)** offer respective goods or perform respective services, accordingly.

Further depicted are three respective charging stations **122(1)**, **122(2)** and **122(3)**. Each of the charging stations **122(1)**-**122(3)** is configured to provide or communicate electrical energy to a respective number of computing devices **102**. The charging stations **122(1)**-**122(3)** may include electronic devices, cabling systems, various electrical connectors or docking ports, inductive-type charging pads, a controller or controllers, power conditioning or voltage regulating circuitry, or other suitable constituency. Each charging station **122(1)**-**122(3)** is also coupled to a source of electrical energy, such as line-level voltage provided by a distribution utility, and so on. In one instance, a charging station **122** may operate "off the grid" by way of solar or wind power, or another independent or renewable resource.

Respective charging stations **122** may be in the form of various computing devices **102**, the accessory device **502** discussed below, or other devices operated by one or more respective users **104**. For instance, a portable computing device **102(1)** may include a finder module **108** or other resources enabling it to report the state of its battery **106** or other energy storage device to a corresponding user **104**. The computing device **102(1)** may then be used to provide electrical energy to another computing device **102(2)** in accordance with an expected short-term usage or other need. Thus, various devices having respective primary functions or applications may also serve in a "limited host" mode so as to provide operating energy to the computing device **102** or other devices. The "limited host" may be limited with respect to the charging station **122** in that other features such as data transfer, rapid charging, multiple device charging capability, and so forth may be unavailable on the "limited host". In another situation, a finder module **108** may be configured to seek another device by way of wireless signals **110** which is able to provide or sell energy resources, determine if such a device is a suitable match based on connector types or reserve energy quantities, and so forth.

In some implementations, matches between users **104** may be facilitated based on other criteria, such as content consumption. For example, the user **104(1)** may have the accessory device **502** which is fully charged, while the user **104(2)** may have a computing device **102** which has an almost empty battery. Both users **104(1)** and **104(2)** may have consumed the same content, such as reading the same book. Based on this common content consumption, and the need of user **104(2)** for a charge, the system may facilitate an introduction of the users **104(1)** and **104(2)** with something in common (the book) such that the computing device **102** may be charged. While the charging is taking place, the two users **104(1)** and **104(2)** may discuss the book they have in common.

The owner of the computing device **102(1)**, accessory device **502**, or other device which provides the electrical energy may receive remuneration or other compensation for providing the electrical energy. For example, government-sponsored currency, virtual currency, points, or other value-keeping units may be exchanged in return for providing the electrical energy, the service, or both.

The charging stations **122** may provide other functionality as well. For example, the charging stations **122** may include an access point **113** or equivalent components, and may provide wireless connectivity to the computing devices **102**.

An illustrative and non-limiting operation is as follows: The user **104** is operating the computing device **102** in a public environment within a threshold distance or otherwise proximate to the respective venues **120(1)**-**120(3)**. The threshold distance may be a fixed value, or may vary based on other conditions. For example, the conditions upon which the threshold distance may be based may include one or more of: time available to charge the computing device **102**, departure time for the user **104**, time before a next meeting, congestion, estimated travel speed, and so forth. For example, the threshold distance for a particular user **104** scheduled to board an aircraft in 15 minutes may be 200 meters, while the same user **104** scheduled to board an aircraft in 45 minutes may have a threshold distance of 500 meters.

The instantaneous voltage of the rechargeable battery **106** may correspond to or be indicative of the remaining electrical energy stored therein that may be drawn or consumed by the computing device **102**. Thus, as usage of the computing device **102** continues, the rechargeable battery **106** exhibits a progressively decreasing voltage.

The finder module **108** includes, or is defined by, an application that runs in the background on the computing device **102**. The finder module **108** may use historical operating or usage data for the computing device **102** to estimate operating energy requirements for given periods of time—in particular, future periods of time. The finder module **108** may also use such historical usage data to estimate the amount of time that the user **104** will continue to operate the computing device **102** before it is recharged. Thus, for instance, the finder module **108** is configured to estimate the amount of electrical energy that is likely to be required for the remainder of the present workday.

The finder module **108** monitors, or receives data from other resources that monitor, the voltage of the rechargeable battery **106**. The finder module **108** compares the present rechargeable battery **106** charge level, which may be determined or estimated from a present voltage measurement, with an estimated need for the remainder of the present operating period and determines that there is likely to be insufficient stored energy. For instance, the present energy storage level of the rechargeable battery **106** may be 20%, while the finder module **108** estimates that a level of 45% is required to complete the anticipated workday, before the computing device **102** is returned to its home charging station. The finder module **108** further estimates, or determines, that approximately twenty-three minutes of charge time, starting now, would charge the rechargeable battery **106** to the estimated or projected need level of 45%.

The finder module **108** accesses the server **112** using wireless signals **110** as a background operation. For instance, cellular or satellite signaling, wireless Internet, Wi-Fi™, or other wireless signals **110** may be used in the interest of sufficient communications range or other considerations. The finder module **108** provides information regarding the present location of the computing device **102**

to the server **112**, as may be determined through satellite navigation, cellular positioning, or another suitable technique. Additionally, the finder module **108** requests information regarding charging stations **122** within accessible venues **120** that are near to the present location of the computing device **102**, for instance, within five hundred feet. Such a distance or range may be a default value, or may be adjustable in accordance with user **104** input, statistical information, or other factors.

The charging module **116** of the server **112** accesses the charging station data **118**, seeking information in accordance with the request sent by the finder module **108**. The charging module **116** determines that three such venues—namely **120**(**1**), **120**(**2**) and **120**(**3**) fit the requested information. The charging module **116** also determines that the venue **120**(**1**)—the retail coffee shop—is the nearest of these to the reported location of the computing device **102**, and that a charging fee of thirty-five cents applies to those wishing to use the charging station **122**(**1**) located therein. The charging module **116** then sends information back to the computing device **102** including the foregoing information, an address for the venue **120**(**1**), and so forth.

The computing device **102** receives the reply from the server **112** and provides it to the finder module **108**. The finder module **108** then interrupts another application that presently being used, such as a spreadsheet application, and presents displayed data **124** on the computing device **102**. As depicted, the displayed data **124** includes the present and estimate battery levels of 20% and 45% respectively, the estimated charging time of twenty-three minutes, and the charging fee of thirty-five cents that may be charged to an account of the user **104**. The displayed data **124** further includes the name, address, and distance to the nearest venue **120**(**1**), the coffee shop, which includes a publically accessible charging station **122**(**1**). The displayed data **124** may also be communicated from the computing device **102** to another computing device **102** such as a smart watch, smart phone, or other device of the user **104**, which may present the displayed data **124**.

Concluding the present example, the user **104** is now aware of the need to charge the rechargeable battery **106** if they wish to continue to use the computing device **102** for the remainder of the anticipated workday. The user **104** may then acknowledge the displayed data **124**, act in accordance therewith or ignore it, or take other action.

The charging module **116** may be further configured to add to, amend, or delete from the charging station data **118** in accordance with information received from any suitable source. In one instance, information regarding respective venues **120** as received from various users **104**, either voluntarily or solicited, may be used to discover new charging stations **122** or to correct existing information, accordingly. In another instance, the operator or entity associated with the server **112** may survey commercial entities, city or county governments, or acquire information from travel or business-oriented services. In yet another instance, the operator of the server **112** may subscribe to an information resource that provides new or amended charger station data **118** on a periodic basis. Other data acquisition techniques may also be used.

In another situation, a user **104** may be in possession of a computing device **102** that has been reported stolen. The user **104** may couple or join such a stolen computing device **102** to a charging station **122**. An identity of the stolen computing device **102**, such as a serial number or other data, may be communicated to the server **112**, which in turn may take corresponding action. In one example, the server **112** may send an alert text message or e-mail to the rightful owner of the stolen computing device **102**, if such contact information is known or accessible. In another example, the server **112** may alert an attendant or other responsible person at the venue **120** of the charging station **122**, such that police or other authorities may be summoned, or the stolen computing device **102** may be confiscated. In still another example, the server **112** may cause one or more functions or applications of the stolen computing device **102** to be disabled, pending input of a reactivation password that is communicated to the rightful owner. In yet another example, a tracking application or signaling circuitry of the stolen computing device **102** may be activated by the server **112**. Other appropriate intervention actions may be taken in view of detecting a stolen computing device **102** by way of a charging station **122**.

In one implementation, the computing device **102**(**1**) may be in the form of a watch or other wearable device that communicates by wireless signals **110** with another computing device **102**(**2**) such as a mobile phone or tablet. In turn, the mobile phone may provide one or more services analogous to the server **112**, or may access resources connected to the networks **114** and provide connectivity or otherwise relay information to the computing device **102**(**1**). Other devices having respective multi-modal capabilities may also be used.

FIG. **2** depicts views **200** including the computing device **102** and other illustrative elements. The views **200** are non-limiting in nature, and other elements, devices, items, or respective operations are also contemplated.

A wireless access point **202** may be configured to couple the computing device **102** in data or signal communication with various entities such as the server **112**, other computing devices **102**, and so on, by way of wireless signals **110**. For instance, such wireless signals **110** may be in accordance with Wi-Fi®, or another protocol. The wireless access point **202** may be further configured to couple to the network(s) **114**. For example, the wireless access point **202** may be located in the coffee shop of the venue **120**(**1**), such that the user **104** may access or browse the Internet using the computing device **102**. In particular, the computing device **102** may access information regarding charging stations **122** by way of the wireless access point **202**.

A network access satellite **204** may be configured to couple the computing device **102** to the internet-based or accessible resources, such as the server **112**, by way of a wireless signals **110** and the network(s) **114**. For example, the network access satellite **204** may allow the user **104** to access information regarding charging stations **122** while in a more remote area, such as at highway rest area, while approaching an urban area. Alternatively, the network access satellite **204** may enable such access while the computing device **102** is being used in an urban, outdoor setting such as a city park.

A cellular tower **206** is also depicted. The cellular tower **206** may be configured to couple the computing device **102** in cellular communication with cellular phones, smart phones, other computing device **102**, Internet-based or connected resources such as the server **112**, and so on. For instance, the user **104** may use the computing device **102** to search for information regarding charging stations **122** by way of wireless signals (i.e., cellular signals) **110** communicated through the cellular tower **206**.

Thus, the computing device **102**, or various other devices, may access, share or exchange data and information with each other or network **114** connected-entities by way of various wireless pathways. The wireless access point **202**,

the network access satellite **204**, and the cellular tower **206** are just three examples of any number of suitable wireless resources contemplated for use by respective computing devices **102**. The computing device **102** or other devices may participate in ad-hoc networks, peer-to-peer networks, or other device groupings or associations for the exchange of data or information, for performing cooperative operations, and so on.

In one example, the user **104** may use the computing device **102** to query the server **112** or another computing entity in regard to charging stations **122** or other services available aboard an aircraft or passenger train. Such a query may be performed in anticipation of travel in the near future, for example. A response to the query may include information regarding charging stations **122**, charging ports available at or near to an assigned seat of the user **104**, availability of digital content that may be provided or purchased during travel, and so on. In this way, a user **104** may inquire as to what computing device-related facilities or resources will be available while flying, traveling by rail, or during other modes of transport.

Illustrative charging station data **118** is also depicted. The charging station data **118** is structured as a data table, wherein each of the respective rows includes information for a particular venue **120**. As depicted, three venues **120** include "coffee shop", "computer store", and "airport", respectively. The charging station data **118** also includes locations **208** for each of the venues **120**. Such location information may be provided or formatted in any suitable way, such as street or mailing addresses, geographical coordinates, relative directions from a present base location, and so forth.

For instance, two respective street addresses are shown for two of the venues **120**, as these are relatively small commercial entities. As such, the user **104** is relatively close to or within visible distance of the corresponding charging station **122** upon entering either of these venues **102**. In contrast, a location in terms of a gate number "B-15" is provided for a charge station **122** located within the "airport", as such a location is relatively vast in area and additional, internal locating information is needed or useful. Additional locating details may also be provided depending upon the nature of a particular venue **120**, such as "20 feet inside from front entrance", "adjacent to restroom area", and so forth.

The charging station data **118** also includes a total number of charging ports **210**, where such information is known for each of the venues **120**. For instance, the charging station **122** accessible at the "coffee shop" includes six total charging ports, and may thus accommodate up to six different computing devices **102**. Similarly, the charging station **122** located near gate "B-15" in the "airport" includes sixteen charging ports. The charging ports **210** information is subject to change as charging ports are added or removed, updated information becomes available or is reported, and so on.

The charging station data **118** also includes charging port availability **212** for each of the venues **120**. The availability **212** data is subject to rapid change and therefore may only be tracked for those venues **120** that report such information on a real-time or nearly real-time basis. For instance, the "coffee shop" reports that two of the six charging ports are presently available, while the "computer store" is reporting that one of six charging ports are currently unused. In turn, the "airport" venue **120** does not report availability information, and thus "N/A" or "not available" is depicted.

The charging station data **118** further includes a reservation **214** indicator or related information for each of the venues **120**. For instance, the "coffee shop" will accept a reservation for a charging port, but will only hold that reservation for the fifteen minutes following the time that it is made. In turn, the "computer store" does not accept charging port reservations. Finally, reservation information for the "airport" is unknown, and thus indicated as "N/A". Other types of information or data may also be included in the charging station data **118**, accordingly. The charging station data **118** depicts information regarding three venues **120** in the interest of clarity. However, data structures or tables may include charging station data **118** corresponding to any suitable number of venues **120** and their respective charging stations **122**.

The charging station data **118** may also include access **216** information regarding any restrictions or authorizations that a corresponding venue **120** imposes on use of the corresponding charging station **122**. For instance, the "coffee shop" and the "airport" venues **120** both offer "public" access to their respective charging stations **122**. In turn, the charging station **122** hosted by the "computer store" is only available to members of a charging or services "club". Thus, a particular privilege or group association is required to use the charging station **122** provided by the "computer store" venue **120**. The access **216** information may include particular details as to which groups, associations, or security clearances are accepted. Furthermore, the finder module **108** may be configured to locate venues **120** associated with one or more particular groups, or may be configured to locate only publicly accessible venues **120**. Other venue **120** filtering or selection criteria may also be used.

The charging station data **118** may also include power parameters **218** information regarding the electrical characteristics of the charging station **122** provided at the corresponding venue **120**. Such power parameters **218** may include available voltages, current capacities, connector specifications or identifiers, availability of induction-type charging pads, or other technical data. The finder module **108** may be configured to locate and present venues **120** based upon particular electrical criteria, as well. The charging station data **118** may further include other information or data for the respective venues **120** such as the availability of secured or locking-type charging ports, connector or computing device **102** compatibilities, accessories or other items offered for rental or sales, and so forth. Other information may also be included in the charging station data **118**, as well.

FIG. **3** depicts views **300** including a user interface **302** and respective elements thereof. The views **300** are non-limiting in nature, and other elements, user interfaces, devices, items, or operations are also contemplated.

The user interface **302** may include or indicate a resource locator **304** corresponding to a network resource provided by the server **112**. In one instance, the user interface **302** is provided or hosted by the finder module **108** and runs or operates on the computing device **102**. Such a user interface **302** presents pieces of information acquired from the computing device **102** or the server **112**, or both. Other operating scenarios may also be used. The user interface **302** also receives user **104** input toward selecting or locating charging stations **122** near to a particular geographic location. In another instance, the finder module **108** or the user interface **302**, or both, is or are provided as an application running on the computing device **102**.

The user interface **302** may also include a battery display **306**. The battery display **306** may include a battery graph

308, which indicates a present condition or level of the rechargeable battery 106 of the computing device 102. The battery graph 308 may also indicate an estimated need level, indicative of an amount of energy required to maintain operation of the computing device 102 for a foreseeable period, such as the remainder of a workday or during scheduled travel by aircraft, and so on. The difference between the present level and the estimated need level represents the amount of energy to be added to the rechargeable battery 106 by way of a charging station 122. Additional description regarding the determination of an estimated need value is provided below with respect to FIG. 6.

The battery display 306 may also include time estimates 310, which may include an estimated time required to charge the rechargeable battery 106 from the present level to the estimated need level. The time estimates 310 may also include an estimated time required to charge the rechargeable battery 106 from the present level to a fully charged state. The time estimates 310 may be presented in terms, of second, minutes, hours, or any other suitable or convenient units. In this way, the user 104 may be informed as to the need to recharge the computing device 102 in order to maintain operations for the foreseeable time period.

The user interface 302 may further include a charging stations display 312. The charging stations display 312 may include textual or graphical information corresponding to one or more accessible venues 120 that host respective charging stations 122. Such venues 120 may be selected in accordance with a range control 314. The range control 314 allows for user 104 input of a distance value, or selection from a predefined list of distance values, from the present location of the computing device 102.

Once the range control 314 is selected or adjusted, the finder module 108 may then request information from the server 112 regarding charging stations 122 within the user-selected distance of the present location of the computing device 102. In another instance, the finder module 108 accesses charging station data 118 stored within the computing device 102 and selects information for corresponding charging stations 122. Other operations may also be performed.

As depicted, three respective venues 120 are located within three-hundred feet of the present location of the computing device 102, and corresponding information for each is presented. For instance, a "coffee shop" venue 120 is the nearest at ninety-one feet away from the computing device 102 location, and includes six charging port, two of which are presently available for use. Reservations are also accepted at the "coffee shop", but such a reservation is only valid for twenty minutes. The "coffee shop" venue 120 also charges a fee of thirty-five cents, and it is possible to order food or drinks in advance by clicking on an additional control.

A reservation selector 316 may be actuated by user 104 input such as touch gesturing, mouse clicking, or another suitable technique. Activation of the reservation selector 316 may cause the finder module 108 to send a request to reserve a charging port 122 to an entity associated with the "coffee shop" venue 120, to the server 112, or another computing device accordingly. A reservation indicator 318 may visually indicate that the reservation has been accepted or successfully made, in accordance with information or signaling received back from the "coffee shop" entity, or the server 112, and so forth. Other sorts of reservation-oriented controls or indicating devices may also be used. Thus, the user 104 may proceed to the "coffee shop" venue 120 with confidence that a charging port 122 has been reserved for their use.

The charging stations display 312 also includes information or details regarding the other two venues 120, a "computer store" and a "bank". As depicted, the three respective venues 120 are presented in ascending order of distance from the present location of the computing device 102. A scroll control 320 allows for the user 104 to scroll through the charging stations display 312, in the event that numerous venues 120 are identified in accordance with the current location or range criteria. The scroll control 320 may be actuated by drag gesturing, mouse dragging, or other suitable user 104 input.

The user interface 302 may also include other input devices, output devices, or controls, such as an execute control 322 configured to cause the finder module 108 perform an operation, request or select information, and so on, based upon user 104 input to respective controls. The user interface 302 may also include an exit control 324 configured to cause the finder module 108 to shut down or close the user interface 302. The execute control 322 or exit control 324, or both, may be actuated by way of touch gesturing, mouse clicking, or another suitable input technique.

FIG. 4 depicts views 400 of elements and processes including the charging of a computing device 102 in an accessible venue. The views 400 are non-limiting in nature, and other elements, process steps, items, or respective operations are also contemplated.

A self-service secure charging station (SSSCS) 402 is depicted. The SSSCS 402 may be provided in the form of a kiosk, a booth, a room within another area or space, as a moveable cart, or in another suitable embodiment. The SSSCS 402 includes three respective charging ports 404(1), 404(2) and 404(3). Each charging port 404(1)-404(3) is configured to communicate, or transfer, electrical energy to a computing device 102 so as to recharge one or more rechargeable batteries 106 therein. The charging ports 404(1)-404(3) may include any suitable electrical connectors, docking features, cabling assemblies, inductive charging pads, wireless communication resources, infra-red or optical transceivers, and so on, so as to "mate" with a given computing device 102. The SSSCS 402 is configured such that the user 104 may use, operate, or access features of the SSSCS 402 without assistance from a clerk, attendant, or other person.

Each charging port 404(1)-404(3) is also configured to couple a computing device 102 in data or signal communication with the server 112, such that digital content 406 may be communicated, or downloaded, to the corresponding computing device 102. Non-limiting examples of such digital content 406 include audio files, video files, advertising matter, travel information, digital photographs, maps, e-books, applications files or upgrades, operating systems or upgrades, data structures, and so on. For instance, a user 104 may opt to purchase an e-book and have it downloaded into their computing device 102—such as an e-book reader—while that computing device 102 is being charged by a particular SSSCS 402.

In another instance, the computing device 102 may be configured to disable communication nodes that are otherwise electrically connected to a charging port 404. For example, the respective data lines of a universal serial bus (USB™) port on the computing device 102 may be deactivated while that port is used to receive charging energy from the SSSCS 402. Thus, information cannot be communicated

to or from the computing device **102** during the charging process. The computing device **102** is therefore protected against data theft, tampering, operating system or application damage, "hacking", or other malicious operations.

Each charging port **404**(**1**)-**404**(**3**) includes a corresponding locking mechanism **408**(**1**), **408**(**2**) and **408**(**3**), respectively, which is configured to lockably secure a computing device **102** in place while it is being charged or communicated with. Locking mechanisms **408** for use with the respective charging ports **404** may include any suitable features or attributes, such as lockable covers or metallic cages that close down over a computing device **102**, enclosed lockers or "cubby holes" with lockable doors, and so on. Other features or configurations may also be used.

Each of the charging ports **404**(**1**)-**404**(**3**) also includes a pager key **410** that is uniquely associated with that particular charging port **404**. As depicted, the pager key **410** is associated with the locking mechanism **408**(**1**) of the charging port **404**(**1**), and none of the others. In one instance, the locking mechanism **408**(**1**) locks, securing a corresponding computing device **102** in place, when the pager key **410** is removed from a corresponding connector port or keyway. In turn, the locking mechanism **408**(**1**) unlocks, thus allowing the computing device **102** to be removed from the charging port **404**(**1**), when the pager key **410** is returned to the corresponding port or keyway.

Additionally, the pager key **410** is configured to receive wireless signals from the SSSCS **402** indicative of a charging status of a computing device **102** being charged by the charging port **404**(**1**). The pager key **410** may, for example, provide a visual, real-time indication of such charging status, provide an audible tone or alert when the charging process is complete, and so on.

A non-limiting operation of the self-service secure charging station **402** is as follows: the user **104** uses the computing device **102** to access the server **112** by way of wireless signals **110**. The user **104** then provides input requesting charging services at the SSSCS **402**, indicates the time period or level of the desired charge, authorizes any fees or charges, selects digital content **406** for download, and so on. The user **104** then connects the computing device **102** to the charging port **404**(**1**) and closes a hinged, transparent cover of the locking mechanism **408**(**1**) there over, and removes the pager key **410** from its corresponding connector. The transparent cover then locks closed, securing the computing device **102** in place, and the charging and/or download process begins.

The user **104** may then move some appreciable distance away, for example within a transportation terminal or other setting. Sometime thereafter, the pager key **410** provides audible or visible alerts to the user **104**, indicating that the charging of the rechargeable battery **106** within the computing device **102** is complete. The user **104** then returns to the SSSCS **402**, placing the pager key **410** in contact with its connector. The transparent cover of the locking mechanism **408**(**1**) then unlocks, accordingly, and the user **104** may remove the computing device **102** from the charging port **404**(**1**) and depart from the area.

In another instance, the user **104** is issued a paging device, or may provide communication information about another computing device **102** in their possession. For example, the user **104** may provide a cellular phone number of their smartphone computing device **102**(**1**) while their tablet computing device **102**(**2**) is being charged. The paging device or other computing device **102** may present information to the user **104** regarding state of charge, time remaining until a charging operation is complete, and so on. Continuing the example, the charging station **122** may send a text message to the user's **104** smartphone computing device **102**(**1**) indicating that the tablet computing device **102**(**2**) is fully charged.

The user **104** may access or unlock the corresponding locking mechanism **408** using a password, combination or code, a signal from a smart watch or smart phone, a mechanical key, or other device. Other methods or systems may also be used.

The SSSCS **402** may also include various batteries **106** that are fully charged and available for rental or purchase by the user **104**. For instance, the user **104** may rent a particular battery **106** for use with the computing device **102** at an SSSCS **402** located in a transportation hub, such as a train station. Such rental may be facilitated, for example, by way of a vending machine or other system, wherein payment is made by way of credit card, cash receiving mechanism, online transaction, or the like. The user **104** then installs the battery **106** within the computing device **102** and uses it during rail travel. The user **104** may then return or "drop-off" the rented battery **106** at a corresponding SSSCS **402** at the destination train station, at a designated drop-off bin, or at some other suitable receiving location. Other temporary use or rental scenarios may also be used.

Also depicted is an attendant operated charging station (AOCS) **412**. The AOCS **412** may be provided in the form of a kiosk, a booth, a room, as a moveable cart, or in another suitable embodiment. The AOCS **412** includes three respective charging ports **404**(**4**), **404**(**5**) and **404**(**6**). Each charging port **404**(**4**)-**404**(**6**) is configured to transfer electrical energy to a computing device **102** so as to recharge one or more rechargeable batteries **106** therein. The charging ports **404**(**4**)-**404**(**6**) may include any suitable electrical connectors, cabling assemblies, docking features, inductive charging pads, wireless communication resources, infra-red or optical transceivers, and so on, so as to "mate" with a respective computing device **102** or other apparatus.

Each charging port **404**(**4**)-**404**(**6**) is also configured to couple a computing device **102** in data or signal communication with the server **112** by way of the network(s) **114**, such that digital content **406** may be communicated or downloaded to a corresponding computing device **102**. For instance, the user **104** may opt to purchase an electronic atlas for an area and have it downloaded into their computing device **102** while that computing device **102** is being charged by a particular AOCS **412**.

The AOCS **412** may also include a battery exchange **414** program or system. The battery exchange **414** may include rechargeable batteries **106** characterized by various makes, models, configurations, capacities, and so forth, which are pre-charged and ready to be used by respectively varying computing devices **102**. In one instance, the user **104** exchanges their existing rechargeable battery **106** for a pre-charged unit available from the battery exchange **414**. A fee or additional service cost may also be applied. In this way, a computing device **102** is effectively "recharged" almost instantaneously, allowing the user **104** to depart from the AOCS **412** immediately.

The AOCS **412** may further include respective rental items **416**. Such rental items **416** may include, without limitation, charging or data signaling cables, connectors, adapters, wall chargers or "bricks", portable charging stations or accessory devices, batteries, carrying cases, and so forth. Other rental items **416** may also be provided. The AOCS **412** may offer to sell one or more of the respective rental items **416**, or other items may be designated for sale only, as well. In one instance, a user **104** may rent a fully

charged battery **106** from an AOCS **412** at a departure airport, draw energy from the rented battery **106** for use of the computing device **102** during flight, and then return the rented battery **106** to another AOCS **412** at a destination airport. Other acquisition-and-return scenarios may also be used. For example, the user **104** may purchase the battery **106** before travel and return after travel for a partial refund or credit.

Operating or "life time" data for respective rental batteries **106** may be tracked and used for various purposes. For example, the charge and discharge cycling history of a particular battery **106** may be recorded and used toward predicting an end-of-life date or estimating a present resale value for that battery **106**. In another example, a given battery **106** may not be offered for rental based on a relatively heavy usage history—that is, such a particular battery **106** may not be reliable for intensive or extended operations. In yet another example, usage data may be used to track energy storage capacity for use in estimating operating times. Energy usage or battery **106** operating data may be applied to other operations, as well.

A non-limiting operation of the AOCS **412** is as follows: the user **104** approaches the AOCS **412** and is greeted by an attendant **418**. The user **104** requests full recharging of their computing device **102**, and provides for payment of any fees or other costs by way of a credit card. The attendant **418** then receives the computing device **102** from the user **104** and connects it to the charging port **404**(**5**), wherein the charging process begins. The attendant **418** then provides a claim tag **420** to the user **104** for use in claiming their computing device **102** later on. Furthermore, the user **104** provides a cellular phone number, for a smart phone **422**, to the attendant **418**. In another instance, the computing device **102** includes a cellular phone number or other contact information corresponding to the smart phone **422** or another computing device **102** associated with the user **104**.

The user **104** may then leave the immediate area, engage in other activities, and so forth, while waiting for the rechargeable battery **106** within their computing device **102** to be recharged. Meanwhile, the attendant **418** may provide the cellular phone number to the server **112** along with information identifying the computing device **102**, method of payment, or other information obtained from the user **104**. Additionally, the computing device **102** may communicate identifying information or other data to the server **112** without attendant **418** intervention. At some later time, the computing device **102** is fully charged, and a corresponding message is communicated through the charging port **404**(**5**) to the server **112**. The server **112** then sends a text message to the smart phone **422** indicative of the completed charging task. The user **104** may now return to the AOCS **412**, and exchange the claim tag **420** for the computing device **102** by way of the attendant **418**.

In another example, the user **104** may bring the computing device **102** to the AOCS **412** or another point-of-sale location, seeking to exchange the computing device **102** for a newer unit, or a different make or model. The attendant **418** may then digitally photograph the exterior features and condition of the computing device **102**, initiate a diagnostic check or other automated evaluation of the computing device **102**, or perform other actions. Data files, applications, digital photographs, audio or video content, and so forth, may then be transferred from the computing device **102** into the replacement unit. Other "trade-in" or exchange operations may also be performed.

In another instance, the same or a similar a "trade-in" procedure may be performed by way of a self-service charging station or self-service secure charging station **402**. In particular, the user **104** may approach the SSSCS **402** and provides input to either the computing device **102** or a terminal or other input device indicating that the user **104** wishes to exchange the computing device **102** toward a newer or different unit. A camera, optical or laser scanner, or other device may be used to evaluate the present condition of the computing device **102** and provides corresponding images or data to the server **112**, or to a remote device or operator. Diagnostics or other procedures may also be performed toward evaluating or rating the condition of the computing device **102**, such that an exchange value may be determined or estimated.

The user **104** may then surrender the computing device **102** to an automated receiving system, and corresponding credit value toward another device is provided by way of a credit card, online debit account, or other suitable procedure to the user **104**. Additionally, data or media files, user profile settings, applications, operating system enhancements, and so on, may be transferred to a replacement computing device **102** at that time, or uploaded to the server **112** for later download when a replacement computing device **102** is acquired by the user **104**. Other procedures may also be performed.

In another instance, the finder module **108** may assist a user **104** so as to identify a kiosk or other location that includes a matching computing device **102**, such as a tablet computer, as they are presently using, but with a battery which has more charge. The matching computing device **102** may include the same memory, exhibit a same or similar overall physical condition, may have the same or similar features, same or compatible installed software, and so forth.

The user **104** may then select that kiosk and pick up a fully-charged, fully-resourced replacement computing device **102** therefrom within a certain time period. While the user **104** is in route to the kiosk, the user's present computing device **102** is communicating with the server **112** so as to provision the replacement computing device **102** with the same settings, user preferences, data files, or other content. Additional content or data may also be downloaded into the replacement computing device **102**, such as a movie from the user **104** "watch list" or other reference file that the user **104** has on their present computing device **102**. The data or file transference to the replacement computing device **102** may be performed by way of secure elements, such as trusted platform modules (TPMs) or other techniques.

Such an operation may help in situations where the computing device **102** does not have an easily replaceable battery **106**, and where the user **104** does not have enough time to charge the battery **106** to an "estimated need" level. The computing device **102** that is surrendered in the exchange can then be inspected by an attendant **418**, or may be sent to some centralized inspection facility to evaluate the condition thereof. If the surrendered computing device **102** is of the same or comparable condition as the replacement computing device **102**, then no further actions may be needed.

However, if the surrendered computing device **102** is of lesser condition, or damaged, an account of the user **104** may be automatically charged the difference in value. Alternatively, a fee to bring the surrendered computing device **102** back to a minimum threshold of usability, which may involve replacing the battery **106**, display, or other elements. If the surrendered computing device **102** is in better condition than the replacement computing device **102**, an account of the user **104** may be credited the difference. The attendant **418** or a central facility may service or refurbish the sur-

rendered computing device **102**, recharge the battery **106**, and use the refurbished computing device **102** to restock the kiosk or another location.

In still another example, numerous users **104**, such as students within an elementary school, high school, college, or another educational or academic institution, may use computing devices **102** that are owned or administrated by the corresponding institution. Such computing devices **102** may be the same type or model, or may vary, and may be tablet computers, e-book readers, media viewers, laptop or wearable computers, or other suitable devices. Such computing devices **102** may be collected at a charging station **122**, kiosk, receiving office or booth, or other designated location as part of a periodic routine for recharging or consumables replenishment, diagnostic evaluation, inspection of physical condition, installation or upgrade of digital content, or other procedures.

A particular computing device **102** may be assigned to a particular student user **104** for the duration of an academic time period, such as a semester or school year. Such assignment may be based on a serial number, a tagging element such as a radio-frequency identification device (RFID), acquisition and storage of a biometric characteristic or "signature" of the user **104**, or another unique association of the user **104** with the computing device **102**. Alternatively, respective computing devices **102** may be issued to respective student users **104** during a daily, weekly, or other periodic distribution, wherein each user **104** is associated with a particular computing device **102** each time, such that a particular computing device **102** is used by numerous different users **104** over the course of an academic year, for example. Other processes may also be used. User **104** profile information or user-established settings, customized preferences, particular applications, data files, and so on, may be transferred from a surrendered computing device **102** to a replacement computing device **102**, if an exchange of such computing devices **102** is performed. Alternatively, such user-specific data or information may be communicated to the server **112** for later download to an exchange computing device **102** as part of an exchange process.

Computing devices **102** may be scanned or evaluated to detect usage or conditions which may be beyond previously established thresholds or standards. For example, the computing devices **102** may be scanned to determine changes in installed software, such as if malicious or unauthorized software is present on the computing device **102**. In another example, the computing device **102** may be analyzed to detect unauthorized use, storage of inappropriate material, or other policy violations. The computing devices **102** may be analyzed subsequent to collection from the users **104**, such as after the students deposit their computing devices **102**. Similar or respectively varying procedures may be used with respect to numerous computing devices **102** associated with members of a group or club, personnel within a clinic or hospital, workers or operators at an industrial site, or in other situations or environments.

FIG. **5** depicts views **500** of elements and processes including the use of an accessory device **502**. The views **500** are non-limiting in nature, and other elements, process steps, items, or respective operations are also contemplated.

The accessory device **502** may include one or more rechargeable batteries **106**. In another instance, the accessory device **502** may include a fuel cell, a capacitor, a super capacitor, or other energy storage devices. Such an energy storage device or devices are thus "rechargeable" or "replenishable" by way of electrical energy, chemical energy or chemical refill, hydrogen-based fuel, one or more fuel cell reactants, or another consumable resource that may be acquired from a suitable source. For example, the accessory device **502** may comprise a plurality of the rechargeable batteries **106** and be described as a rechargeable battery pack. In another example, the accessory device **502** may comprise a plurality of the fuel cells, capacitors, and so forth, and be described as a rechargeable energy pack. The accessory device **502** may also be referred to as a rechargeable energy pack **502** or rechargeable battery pack **502**, as well.

The accessory device **502** may include power transistors or other switching elements configured to couple two or more batteries **106** in various series, parallel, or series-parallel circuit configurations. Thus, the batteries **106** of the accessory device **502** may be selectively electrically reconfigurable so to provide different voltages or charging currents, or accommodate other electrical parameters.

The accessory device **502** also includes an operating module **504**. The operating module **504** may include electronic circuitry or respective electronic circuits, one or more processors **504(1)**, computer-executable code stored on non-transitory storage media, indicating lights or an electronic display, pushbuttons or other user input devices, and so forth. The operating module **504** may also include wired or wireless communication interfaces **504(2)** configured to communicate data, information, or other signals with other devices or entities.

The operating module **504** may further include one or more respective sensors **504(3)**. The sensor(s) **504(3)** may include one or more thermometers for measuring battery **106** temperature or ambient temperatures, a global positioning system (GPS) receiver or other satellite-based locating resource, an ambient light sensor, or various other detectors or instrumentation. The operating module **504** may include other suitable constituency, as well. The operating module **504** is configured to perform or control various operations of the accessory device **502**. The accessory device **502** may also include one or more components or elements as described herein for the computing device **102**. Thus, the accessory device **502** is not limited with respect to any suitable resources or functions that it may include.

The accessory device **502** may be configured to perform various respective functions, or include one or more accessories, as well. In one instance, the accessory device **502** may include a detachable flashlight or other convenience. In another instance, the accessory device **502** also functions as a "digital wallet" for the user **104**, wherein virtual currency or digital tokens may be communicated therefrom to a smart phone or other device. The accessory device **502** may include a near-field communication (NFC) module to facilitate the communication of these digital tokens, virtual currency, or other data. In yet another instance, the accessory device **502** is configured and resourced to operate as a Wi-Fi™ "hot spot". Other functions or operations may also be included.

The accessory device **502** may also include historic usage data **506**. The historic usage data **506** may be stored on storage media, organized as one or more various data structures, and so forth. The historic usage data **506** may include, describe, or quantify information regarding power consumption by one or more respective load devices **508**, such as computing devices **102**, power tools, media devices, wearable computers, portable appliances, test equipment, diagnostic devices, and so forth. For instance, the historic usage data **506** may include data regarding power or electrical current consumption over time as a particular load device **508** is used to perform various tasks. In another

example, the historic usage data **506** may be used to provide a reminder to a user **104** to recharge batteries **106** within portable power tools before heading to a worksite at the beginning of a workday. The historic usage data **506** may also be used in other ways.

In another instance, the historic usage data **506** may include one or more "power curves" or functions quantifying energy consumption for a given load device **508** over a particular period of time, such as a specific or averaged workday, weekend day, and so forth. The historic usage data **506** may be acquired from respective load devices **508**, such as the computing device **102** or the smart phone **422**, or may be generated by operation of the operating module **504**, or acquired or generated by way of other operations.

The historic usage data **506** may correspond to one or more load devices **508** that do not include wireless, network-based, or other communications capabilities. For instance, the accessory device **502** may measure, track, or record historic usage data **506** for a particular device that is not configured to communicate such information to the server **112** or another entity. The accessory device **502** may then process such historic usage data **506**, forward that historic usage data **506** or corresponding information to the server **112**, or perform other operations on behalf of that device. For instance, the accessory device **502** may be configured to provide a certain amount of energy—for example, 500 milliampere-hours—to the computing device **102**, determining that the energy storage of the computing device **102** is now "full". This energy provisioning data may be used by the operating module **504** for future estimating purposes, communicated to the server **112**, and so on.

The accessory device **502** may also include one or more power profiles **510**. Each power profile **510** may predict or "model" energy consumption over time corresponding to a particular task or function performed by a given load device **508**. For instance, a power profile **510** may predict electrical consumption by the computing device **102** during the presentation of a 2-hour audio/video presentation or movie. In another instance, a power profile **510** may predict electrical consumption by the smart phone **422** during a cellular phone call of 10 minutes duration. In yet another instance, a power profile **510** may predict electrical consumption by the computing device **102** during an upcoming 4-hour flight. Other units of measure, time correspondences, and so forth, may be used to define respective power profile **510**.

Such power profiles **510** may be predefined and acquired from a manufacturer, vendor, or other source associated with a particular load device **508**. In another example, power profiles **510** corresponding to respective applications running on particular load devices **508** may be acquired from sources or vendors of those applications. In one case, a power profile **510** may be defined in terms of instantaneous power consumption, such as Watts, which may be multiplied by a period of time, such as minutes or seconds, in accordance with an actual or estimated usage time for that application. In another case, a power profile **510** maybe defined in terms of total power consumption, such as milliampere-hours, over a predetermined period of time, such as 1 hour. In still another case, the operating module **504** may record historic usage data **506** for a particular load device **508**, and then process that historic usage data **506** so as to generate one or more power profiles **510**. Other power profile **510** methodologies may also be used.

The accessory device **502** may be configured to be coupled to an external source of electrical energy, such as a charging port **404**. Charging power **512** is then received by the accessory device **502** and used to charge the battery **106** under the control of the operating module **504**. The charging power **512** may be alternating current (AC), direct current (DC), or characterized by respectively different voltages. In another instance, the accessory device **502** may be equipped to receive electrical energy from an external source by way of wireless power transfer.

The operating module **504** may also control provisioning of electrical power to respective load devices **508**. In one example, the accessory device **502** includes a USB™ port that is configured to connect to the charging port **404** and to receive the charging power **512**. Other protocols may also be used, such as a serial or parallel communications port, Firewire®, Apple desktop bus (ADB), High-Definition Multimedia Interface (HDMI)®, or other suitable protocols and their corresponding connectors. In turn, the accessory device **502** may be further configured to disable data or communication lines of the USB™ port so as to prevent damage or data theft by malicious entities. In another example, the accessory device **502** may include a USB™ or other port that is completely lacking data or communication lines, and is thus configured for charging purposes only.

In yet another example, the accessory device **502** may be equipped to provide charging power to respective load devices **508** by way of wireless power transfer or other devices. In still another example, the operating module **504** may prioritize or apportion the allocation of power to respective load devices **508** based on the historic usage data **506**, one or more of the power profiles **510**, upcoming events such as air travel or a vacation, and so on. Other suitable configurations or methods may also be used.

In another instance, the operating module **504** of the accessory device **502** may use the historic usage data **506**, one or more of the power profiles **510**, or some combination of these to estimate future energy requirements of one or more load devices **508**. The operating module **504** may then use the estimate or estimates to calculate or determine a quantity of energy to be stored in the battery(s) **106** of the accessory device **502**, and control charging of the battery(s) **106** accordingly. Thus, the accessory device **502** may be configured to "store up" sufficient energy, as received from the charging port **404** or another external source, so as to provide for predicted energy needs of various load devices **508** during future operations, such as during business travel, vacationing, and so forth.

For example, the computing device **102** may be coupled to the accessory device **502** by way of a wired connection such that power and data **514** may be communicated there between. In one example, the power and data **514** are communicated using a USB™ protocol. Information regarding present battery **106** levels of the computing device **102** or the accessory device **502**, or both, may be shared between these respective devices by way of the power and data **514**. The computing device **102** and the accessory device **502** may also be respectively configured to communicate data or information with each other using wireless signals **110**, such as Wi-Fi™, Bluetooth®, and so on.

Additionally, the historic usage data **506**, one or more of the power profiles **510**, or other data or information may be communicated between the computing device **102** and the accessory device **502**. The power and data **514** may further provide electrical energy from the accessory device **502** to the computing device **102** for recharging or replenishing the battery **106** or other energy storage device thereof.

In another instance, the accessory device **502** may provide power **516** to the smart phone **422** by way of a wired connection. Thus, the accessory device **502** may provide electrical energy for recharging or replenishing an energy

storage device, such as a battery **106**, of the smart phone **422**. As depicted, the smart phone **422** may be configured to communicate a present level of such an energy storage device, historic usage data **506**, power profiles **510**, or other data or information to the computing device **102** by way of wireless signal **110**, such as Wi-Fi™, Bluetooth®, and so forth.

The computing device **102** may also include a management module **518**. The management module **518** may include any suitable constituency, such as electronic circuitry, dedicated purpose electronic devices, a processor device, executable program code stored in non-transitory storage media, and so forth. Other suitable elements or devices may also be included or used. The management module **518** may be configured to communicate data or information to and from the smart phone **422**, the accessory device **502**, or both of these or other devices. The management module **518** may also be configured to present information to a user **104** regarding the status of battery **106** charging operations, estimate available operating times for the respective load devices **508**, and perform other operations.

The management module **518** may also be configured to prioritize the allocation of battery **106** energy to certain applications or resources of the computing device **102**. For instance, the user **104** may provide input indicating that e-mail and word processing applications have a higher priority than a movie playback application while the computing device **102** is being used during travel. Thus, the management module **518** may be configured to disable user-designated applications or functions during travel or other circumstances, so as to conserve stored energy in the battery **106** for business purposes. In another instance, the management module **518** may be configured to prioritize or curtail energy provisioning to certain resources, functions, or applications of the computing device **102** based on historic usage data **506** or power profiles **510**—that is, to manage power allocation without need for user **104** intervention. Other energy management functions may also be used.

The accessory device **502** may be further configured to communicate with the server **112** by way of the one or more networks **114**. The accessory device **502** may acquire or supplement the historic usage data **506** or the power profiles **510**, or both, in this way. The accessory device **502** may also acquire digital content **406** from the server **112** for storage within media of the accessory device **502**, for communication to the computing device **102**, and so on. For instance, the accessory device **502** may communicate data, energy levels, time periods, or other information regarding the charging of a battery **106** or other energy storage device within one of the load devices **508**. Other operations or functions may be performed by way of power and data **514** signaling between the server **112** and the accessory device **502**.

In one illustrative and non-limiting operation, the user **104** couples the accessory device **502** to a charging port **404**. The operating module **504** then controls or regulates the charging of the battery(s) **106** using the charging power **512**. The user **104** then allows sufficient time for the battery(s) **106** of the accessory device **502** to charge to a level of, for instance, 93% of their total energy storage capacity. The user **104** then disconnects the accessory device **502** from the charging port **404**, packing it along with the computing device **102** and the smart phone **422** in preparation for business travel. In one example, the accessory device **502** may communicate data to or from the charging port **404** during the receiving of charging power **512** therefrom. For instance, a USB® or other port of the accessory device **502** may be used for both data communication and charging power **512** reception.

Upon arriving at a transportation hub, the user **104** connects the computing device **102** and the smart phone **422** to the accessory device **502** by way of respective wired connections. The smart phone **422** communicates a present level of its battery **106** to the computing device **102** by way of wireless signals **110**. In turn, the computing device **102** communicates the present battery **106** level of the smart phone **422** to the accessory device **502** by way of the power and data **514**. The computing device **102** communicates the present level of its own battery **106** to the accessory device **502**, as well.

The operating module **504** then accesses the historic usage data **506**, or one or more of the power profiles **510**, and uses these along with the respective battery **106** levels, to estimate potential operating times for the computing device **102** and the smart phone **422**, respectively. In one instance, the estimated operating times may be based on "worst case" or "pessimistic" power profiles **510**, wherein it is assumed that operations at or near maximum power consumption intensity may be performed by the computing device **102** or the smart phone **422**, or both. In another instance, the estimated operating times may be based on historic usage data **506** corresponding to previous business travels. Other estimating methods may also be used.

Moreover, estimated operating times may be based on the present level of the battery(s) **106** of the accessory device **502**, while other estimated operating times are based on the present levels of the battery **106** of the computing device **102** and the smart phone **422**, respectively. Other estimated operating times or basis may also be used. The respective operating time estimates and battery **106** levels are then communicated to the computing device **102** by way of the power and data **514** signals.

The management module **518** receives the operating times and battery **106** levels and uses this information to present displayed data **124**. As depicted, the present level of 93% of the accessory device **502** presented, as well as a time estimate of 22 minutes to charge the accessory device **502** to 100% of capacity. Such charge time information may be useful to the user **104** in the event that an opportunity to fully charge the accessory device **502** presents itself.

As also depicted, it is estimated that the accessory device **502** stores sufficient energy within its battery(s) **106** to power the computing device **102**, alone, for a total of 8 hours and 15 minutes. In turn, it is estimated that the accessory device **502** stores sufficient energy to power the smart phone **422**, alone, for a total of 25 hours and 30 minutes.

As further depicted, it is estimated that the computing device **102** has enough energy within its own battery **106** to operate for 4 hours and zero minutes, while it is estimated that the smart phone **422** has sufficient stored energy to operate for 7 hours and 20 minutes. Finally, total estimated operating times of 12 hours and 15 minutes for the computing device **102**, and 32 hours and 50 minutes for the smart phone **422**, are depicted. These total operating times are based on transferring the stored energy of the accessory device **502** to the computing device **102** or the smart phone **422**, respectively.

FIG. **6** depicts views **600** include respective power profiles **510**. The power profiles **510** and their respective characteristics are illustrative and non-limiting in nature, and other power profiles **510** having other respective characteristics are also contemplated.

A power profile **510**(**1**) depicts a time-dependent, average power consumption curve for a particular load device **508**. For instance, the power profile **510**(**1**) may depicts the average power consumption profile for the computing device **102** over the course of a workday. Specifically, the power profile **510**(**1**) is a curve, or locus, defined by a multitude of instantaneous power consumption **602** values, in units of Watts, plotted with respect to time **604**. Thus, the power profile **510**(**1**) may correspond to various operations that are performed by the computing device **102**, such as viewing or answering e-mail, generating an electronic document, producing a business presentation or slideshow, and so on, by way of one or more respective applications. The power profile **510**(**1**) may be used to predict or estimate the battery **106** level that is required to operate the computing device **102** for an average workday.

The power profile **510**(**2**) depicts a time-dependent power consumption curve for a particular load device **508**, such as the computing device **102**, over the course of an average weekend day. The power profile **510**(**2**) may be indicative of operations such as answering e-mail, accessing social media, playing a game, locations where various operations or communication were performed, and so forth, using respective applications. For instance, locations where wireless connectivity is weak or intermittent may result in increased energy consumption from a battery **106**. Thus, location may be germane to one or more respective power profiles **510**. It is noted that the power profile **510**(**2**) is indicative of both overall energy consumption and intensity that are lesser than that of the power profile **510**(**1**).

Thus, as depicted in this example, more energy is drawn from the battery **106** of the computing device **102** during the course of an average weekday relative to an average weekend day. The power profiles **510**(**1**) and **510**(**2**) may be used by the operating module **504**, or the management module **518**, or both, in order to estimate required battery **106** levels for operating during weekdays or weekend days, respectively. Moreover, the power profiles **510**(**1**) or **510**(**2**) may be adjusted or modified over time as computing device **102** usages or energy consumption patterns change.

In one instance, the server **112** acquires historic usage data **506** from a single computing device **102**, or from a population of respective computing devices **102**, and generates or adjusts respective power profiles **510** accordingly. Such acquisition, processing, or generation may be performed either continuous in real time, periodically in a batch-like manner, or both. These adjusted power profiles **510** may then be communicated to respective computing devices **102**, to accessory devices **502**, and so on. Thus, "cloud" based acquisition or processing of historic usage data **506**, or the generation of respective power profiles **510**, is contemplated. In another instance, the management module **518** of the computing device **102** generates or adjusts respective power profiles **510** over time in accordance with detected energy consumption patterns or trends. In yet another instance, the operating module **504** or other resources of the accessory device **502** may acquire historic usage data **506** or generate or adjust various power profiles **510**. Other methods may also be used.

Also depicted is an illustrative power profile **510**(**3**), corresponding to energy consumption over time for a computing device **102** used during a 4-hour flight. The power profile **510**(**3**) includes a first portion **606** indicative of energy used during presentation of a 2-hour movie. The power profile **510**(**3**) also includes a second portion **608** corresponding to energy used during a 1-hour business slideshow. The power profile **510**(**3**) also includes a third portion **610** corresponding to energy used while drafting e-mail messages for 1 hour.

In one respect, the power profile **510**(**3**) is defined in a piece-wise manner, in accordance with three respective operations or tasks: viewing a movie, viewing a slideshow, and composing e-mail messages. In one example, the power profile **510**(**3**) may be used by the management module **518** in order to estimate power consumption and required battery **106** level for an upcoming flight as indicated by a calendar function on the computing device **102**. In another example, the respective portions **606**-**610** of the power profile **510**(**3**) may be used by the operating module **504** so as to estimate a required battery **106** level in accordance with respective functions to be performed using the computing device **102**. Other operations using the respective power profiles **510**(**1**), **510**(**2**) or **510**(**3**) may also be performed.

One or more of the respective power profiles **510**(**1**)-**510**(**3**) may be based at least in part on corresponding historic usage data **506**. In another instance, one or more of the respective power profiles **510**(**1**)-**510**(**3**) may be generated by either the operating module **504** or the management module **518**, or both, based on detected or inferred load device **508** usage patterns. For example, if the user **104** acquires digital content **406**, such as a movie, and a calendar function of the computing device **102** indicates that a flight is scheduled for the near future, the management module **518** may estimate the battery **106** level required to view the movie during the flight. In another example, a particular power profile **510** may be generated by an engineer or other skilled user **104** as one of numerous power profiles **510** corresponding to travel-related load device **508** usage.

The power profiles **510** or respective portions **606**-**610** thereof may also be used to dynamically adjust power consumption by the computing device **102**, or other energy-consuming device such that operations may be performed for a particular period of time before recharging. For example, the management module **518** of the computing device **102** may estimate that 5 more hours of operating time are likely required before a routine recharging of the battery **106** begins. Based on the present level of the battery **106** and a corresponding power profile **510**, the management module **518** determines that certain resources of the computing device **102** should be shut down or inactivated so as to conserve sufficient energy to allow for the predicted 5 hours of operation.

Continuing the present example, the management module **518** may present information regarding recommended energy conservation efforts, which may include a number of options for the user **104** to choose from. For instance, the user **104** may elect to shut down a wireless modem or other communications resource, as such is not foreseen as being needed for the remaining operating period. In another instance, the user **104** may be prompted to authorize the inactivation of one or more applications toward reducing processor load and thus decreasing energy consumption. Shut down operations may be repeated or intensified incrementally over time so as to provide for the remainder of the estimated operating time.

In another example, the management module **518** may shut down one or more resources of the computing device **102** as an automatic or "background" operation, without user **104** prompting or intervention, based on present or near-future circumstances. For instance, the management module **518** may determine that the computing device **102** is presently being used during a business flight by accessing a travel scheduling entry within a calendar. If the computing

device **102** is being used to view a movie during the flight, the management module **518** may shut down one or more wireless functions, a radio receiver, or other resources not germane to the present usage. The management module **518** may also access one or more power profiles **510** toward determining or prioritizing one or more resources that may be shut down during travel or other circumstance. In yet another example, the management module **518** may periodically inactivate or shut down selected resources in the interest of energy conservation and extended operating time for the computing device **102**. For instance, the management module **518** may inactivate an application running in the background from time to time, re-activating it only when needed so as to reduce processor workload and conserve energy accordingly. Other energy conservation measures may also be automated such that the user **104** is unaware of their occurrence.

FIG. **7** illustrates a block diagram **700** of a computing device **102**. The computing device **102** is illustrative and non-limiting, and may be defined by a desktop computer, a tablet computer, a wearable computer, an e-book reader, a media device, a cellular phone, a laptop computer, or another suitable apparatus. The computing device **102**, or functions or constituents thereof, may also be included within an electric vehicle or other device or system. The computing device **102** may include one or more processors **702** configured to execute one or more stored instructions. The processor(s) **702** may comprise one or more cores, and may also be referred to as hardware processors.

The computing device **102** may include one or more I/O interface(s) **704** to allow the processor(s) **702** or other portions of the computing device **102** to communicate with various other computing devices **102**, other user devices, the server **112** or other servers, various web-based resources, and so on. The I/O interfaces **704** may be configured to operate in accordance with various protocols such as I2C, SPI, USB, RS-232, and so forth.

The I/O interface(s) **704** may couple to one or more I/O devices **706**. The I/O devices **706** may include one or more input devices such as a keyboard, a mouse, a microphone, a digital camera, user input buttons, and so forth. The I/O devices **706** may also include output devices such as one or more displays **708**, audio speakers, haptic output devices, and so forth. The I/O devices **706** may also include respective navigation resources **710** such as, without limitation, satellite-based navigation or positioning such as the global positioning system (GPS) or the global navigation satellite system (GLONASS), cellular tower-based locating, inertial navigation devices or systems, radio-based navigation, one or more navigational gyroscopes, and so on. In some embodiments, the I/O devices **706** may be physically incorporated within the computing device **102**, or they may be externally placed. The I/O devices **706** may include various other devices, as well.

The computing device **102** may also include one or more communication interfaces **712**. The communication interfaces **712** are configured to provide communications with other computing device **102**, web-based resources, servers **112**, routers, wireless access points **202**, network access satellites **204**, cellular towers **206**, and so forth. The communication interfaces **712** may include wireless functions, devices configured to couple to one or more networks including LANs, Wireless-LANs, WANs, Wireless-WANs, and so forth. The computing device **102** may also include one or more busses or other internal communications hardware or software that allow for the transfer of data between the various modules and components of the computing device **102**. The computing device **102** may also include one or more rechargeable batteries **106**, as described elsewhere herein. Alternatively, the computing device **102** may draw operating power from a fuel cell, super capacitor, flywheel, or another suitable, replenishable energy source or storage device.

The computing device **102** includes one or more memories **714**. The memory **714** comprises one or more computer-readable storage media (CRSM). The memory **714** provides storage of computer readable instructions, data structures, program modules, and other data used during the operation of the computing device **102**. The memory **714** may include at least one operating system (OS) module **716**. Respective OS modules **716** are configured to manage hardware devices such as the I/O interfaces **704**, the I/O devices **706**, the communication interfaces **712**, and provide various services to applications or modules executing on the processors **702**.

Also stored in the memory **714** may be one or more of the following modules. These modules may be executed as foreground applications, background tasks, and so forth. A user interface module **718** may be configured to provide one or more user interfaces **302**, and may also provide one or more application programming interfaces. The user interface module **718** may be configured to operate with information encoded as hypertext markup language ("HTML") files, extensible markup language ("XML") files, or in another suitable format or language. The user interface module **718** is configured to accept inputs and send outputs using the I/O interfaces **704**, the communication interfaces **712**, or both.

The memory **714** may also store one or more application modules **720**. Non-limiting examples of the application modules **720** include a word processing application, a spreadsheet application, a technical drawing or illustrating application, a photo editing application, a web browsing application, a portable document viewing application, and so on. The memory **714** may also include the finder module **108** or the management module **518** as respectively described elsewhere herein.

The memory **714** may also include a calendar module **722**. The calendar module **722** may include data structure, electronic circuitry, executable program code, and so forth; so as to track various scheduled events, appointments, and the like. For instance, the finder module **108** may access scheduling data, such as air travel flight times or upcoming meetings, within the calendar module **722** for use in determining or recommending rechargeable battery **106** charging times, projecting future energy needs, or for other purposes. The memory **714** may also include one or more other modules **724**. Non-limiting examples of the other modules **724** may include cellular communications circuitry, a watchdog or other timer, a wireless internet transceiver, hardware resources for satellite communications or navigation, and so forth.

The memory **714** may also include a datastore **726** to store information. The datastore **726** may use a flat file, database, linked list, tree, executable code, or other data structure to store the information. In some implementations, the datastore **726** or a portion of the datastore **726** may be distributed across one or more other computing devices **102** or other devices including servers **112**, network attached storage apparatus, and so forth.

The datastore **726** may store one or more data structures including charging station data **118**, or other related information. The datastore **726** may also include historic usage data **506** or one or more power profiles **510** as respectively described elsewhere herein. The historic usage data **506** may include data, statistics, or information regarding usage of the

computing device **102** such previous time spans of operation, time-of-day data related to operation, quantities of energy or level differentials drawn from the rechargeable battery(s) **106** during operation, charging times required to recharge the rechargeable battery(s) **106** between respective lesser and greater levels, and so forth. The historic usage data **506** may be accessed and used, and new or amended data may be stored therein, by respective operations of the finder module **108**.

For instance, the historic usage data **506** may include average operating time periods, start and stop times-of-day, battery level (i.e., voltage) changes correlated to respective operation periods, and so forth. Other suitable data or information may also be stored in, or read from, the historic usage data **506** such that the finder module **108** may estimate future energy requirements based on the past performance of the computing device **102**. In another instance, the finder module **108** tracks rechargeable battery **106** level changes and operating time spans for each usage session, stores this data within the historic usage data **506**, such that a growing data set of performance-related information is acquired for present or future use. Other operations or techniques may also be used.

The datastore **726** may also store other data **528**. For example, the other data **728** may include one or more data structures that may be queried, modified, amended, and so forth. The other data **728** may also include encryption keys or codes used to access a server or servers **112**, or when communicating with network-based resources, and so forth. Accordingly, respective computing devices **102** may be resourced and configured to perform numerous functions, as well as to cooperate with one or more other computing devices **102** or apparatus.

FIG. **8** illustrates a block diagram **800** of a server **112**. The server **112** is illustrative and non-limiting, and may be defined by a rack-mounted server or another suitable apparatus. The server **112** may include one or more processors **802** configured to execute one or more stored instructions. The processor(s) **802** may comprise one or more cores, and may also be referred to as hardware processors.

The server **112** may include one or more I/O interface(s) **804** to allow the processor(s) **802** or other portions of the server **112** to communicate with various computing devices **102**, other servers **112**, user devices, web-based resources, and so on. The I/O interfaces **804** may be configured to operate in accordance with various protocols such as I2C, SPI, USB, RS-232, and so forth.

The I/O interface(s) **804** may couple to one or more I/O devices **806**. The I/O devices **806** may include one or more input devices such as a keyboard, a mouse, a microphone, a camera, user input buttons, and so forth. The I/O devices **806** may also include output devices such as one or more displays, audio speakers, haptic output devices, and so forth. In some embodiments, the I/O devices **806** may be physically incorporated within the server **112**, or they may be externally placed.

The server **112** may also include one or more communication interfaces **808**. The communication interfaces **808** are configured to provide communications with other servers **112**, various computing devices **102**, web-based resources, routers, wireless access points, and so forth. The communication interfaces **808** may include wireless functions, devices configured to couple to one or more networks including LANs, Wireless-LANs, WANs, Wireless-WANs, and so forth. The server **112** may also include one or more busses or other internal communications hardware or software that allow for the transfer of data between the various modules and components of the server **112**.

The server **112** includes one or more memories **810**. The memory **810** comprises one or more CRSM. The memory **810** provides storage of computer readable instructions, data structures, program modules, and other data for the operation of the server **112**. The memory **810** may include at least one operating system (OS) module **812**. Respective OS modules **812** are configured to manage hardware devices such as the I/O interfaces **804**, the I/O devices **806**, the communication interfaces **808**, and provide various services to applications or modules executing on the processors **802**.

Also stored in the memory **810** may be one or more of the following modules. These modules may be executed as foreground applications, background tasks, and so forth. A user interface module **814** may be configured to provide one or more user interfaces, such as the user interface **302**, or aspects or variants thereof, in accordance with signaling or commands from the charging module **116**. The user interface module **814** may also provide one or more application programming interfaces. The user interface module **814** may be configured to operate with information encoded as hypertext markup language ("HTML") files, extensible markup language ("XML") files, or in another suitable format or language. The user interface module **814** is configured to accept inputs and send outputs using the I/O interfaces **804**, the communication interfaces **808**, or both.

The memory **810** may also store one or more application modules **816**. Non-limiting examples of the application modules **816** include a word processing application, a data encrypting or decrypting application, a data structure generation or management application, a web browsing application, a portable document generating or viewing application, and so on.

The memory **810** may further store a communications module **818** such that charging station data **118**, related information, user interfaces **302**, or other data, may be communicated to and from respective computing devices **102**. In one example, the communications module **818** includes executable program code, electronic circuitry, or other resources used to transmit and receive wireless signals, signals by way of wired or optical pathways, or in accordance with other techniques. The memory **810** may also store the charging module **116** as described elsewhere herein.

The memory **810** may also include one or more other modules **820**. Non-limiting examples of the other modules **820** may include cellular communications circuitry, a watchdog or other timer, a wireless internet receiver, secured data handling or communications resources, and so forth.

The memory **810** may also include a datastore **822** to store information. The datastore **822** may use a flat file, database, linked list, tree, executable code, or other data structure to store the information. In some implementations, the datastore **822** or a portion of the datastore **822** may be distributed across one or more other servers **112** or computing devices, network attached storage apparatus, and so forth.

The datastore **822** may store charging station data **118** as described elsewhere herein. The datastore **822** may also store various types of the digital content **406**. The datastore **822** may further store the historic usage data **506** or one or more power profiles **510** as respectively described elsewhere herein. The datastore **822** may further store other data **824**. For example, the other data **824** may include one or more data structures that may be queried, modified, amended, and so forth.

FIG. **9** is a flow diagram **900** illustrating a process including charging a rechargeable battery **106** of a computing device **102** in accordance with an estimated requirement. The process of the flow diagram **900** is illustrative and non-limiting, and other processes including one or more other steps, omitting one or more of the depicted steps, or proceeding in other orders of execution, may also be used.

Block **902** determines present and estimated battery **106** levels and a charging time based on historic usage data **506** of a computing device **102**. For purposes of a present example, the user **104** is using the computing device **102**, such that electrical energy is being drawn from the rechargeable battery **106**. The finder module **108** monitors the present level of the rechargeable battery **106**, which for instance is 30%. The finder module **108** also accesses historic usage data **506** and determines that the user **104** will likely want to operate the computing device for another five hours before connecting the computing device **102** to recharge overnight.

The finder module **108** further determines that the rechargeable battery **106** likely requires a level of 65% in order to continue powering the computing device **102** for the estimated five hour time span. Thus, an estimated rechargeable battery **106** level deficiency of 35% exits. Additionally, the finder module **108** estimates that thirty-four minutes of charging time will raise the rechargeable battery **106** from its present 30% level to the estimated 65% need level.

Block **904** presents information regarding the rechargeable battery **106** levels and the estimated charging time. In the present example, the finder module **108** causes a user interface **302** to be presented on a display **708** of the computing device **102**. The user interface **302** includes a battery display **306**, with a battery graph **308** that graphically and textually depicts the present 30% level and the estimated need 65% level of the rechargeable battery **106**. The battery display **306** also includes time estimates **310**, depicting the estimated charging time of twenty-three minutes. As such, the user **104** is now aware that the rechargeable battery **106** probably has insufficient stored energy to power the computing device **102** for the remainder of the anticipated usage period.

Block **906** acquires, by wireless signaling **110**, information regarding nearby charging stations **122**. In the present example, the finder module **108** sends a request to the server **112** seeking information regarding charging stations **122** within accessible venues **120** near to the present location of the computing device **102**. The request may include a present geolocation for the computing device **102**, information regarding charging port **404** requirements, or other information germane to the charging of the computing device **102**. The server **112** responds by accessing the charging station data **118** and selecting charging stations **122** with a prescribed or default distance of the computing device **102**, such as three hundred feet. Such a distance may be set or selected by way of the range control **314**. Information regarding three particular charging stations **122** is then communicated from the server **112** to the computing device **102**, by way of the wireless signals **110**.

Block **908** presents the information regarding the nearby charging stations **122**. In the present example, the user interface **302** is updated, adding the charging stations display **312**, including information regarding three particular charging stations **122** located within respective accessible venues **120**. Such information may include distances from the computing device **102** to each of the charging stations **122**, numbers of charging ports **404** and their availabilities, additional goods or services that may be offered by the respective venues **120**, and so on.

Block **910** sends, by wireless signaling **110**, a request to reserve a charging port **404** at a selected charging station **122**. In the present example, the user **104** selects the charging station **122** associated with the "coffee shop" venue **120**, and actuates a reservation requester **316** device. The finder module **108** responds to this user **104** input and sends a request to a computing entity associated with the "coffee shop", requesting that one of the charging ports **404** be reserved. The request may also include payment information or other data as needed so as to complete or validate the requested transaction.

Block **912** presents information corresponding to a response to the request. In the present example, the computing entity associated with the "coffee shop" validates the request to reserve a charging port **404**, and sends a corresponding verification back to the computing device **102** by way of wireless signals **110**. The user interface **302** is updated accordingly, and a reservation indicator **318**, depicted as a checkmark within a circle, is presented adjacent to the reservation selector **316**. The user **104** is now aware that a charging port **404** at the "coffee shop" has been reserved, provided that they arrive within twenty minutes to claim it.

Block **914** sends, by wireless signaling **110**, an order for goods or services offered at a venue **120** of the selected charging station **122**. In the present example, the user **104** clicks or otherwise actuates a control corresponding to food and beverage orders offered by the "coffee shop" venue **120**. A corresponding signal is sent to the computing entity associated with the "coffee shop", and a menu or other information is provided back to the computing device **102**. The menu or related information may be presented as a different user interface **302**, for instance. The user **104** may then select food items, beverages, or other items and transact an electronic purchase accordingly, before arriving at the "coffee shop". Other similar actions corresponding to an electronic marketplace may also be performed.

Block **916** performs one or more actions regarding charging the battery **106** of the computing device **102**. In the present example, the user **104** proceeds to the "coffee shop" venue **120** and locates the charging station **122** there within. The user **104** may communicate with an attendant **418** or other personnel with respect to accessing and using the reserved charging port **404**. The computing device **102** is then coupled or suitable mated to the charging port **404**, and charging of the rechargeable battery **106** begins. The user **104** may then pickup and enjoy the food or beverage items they ordered in advance, while waiting for the computing device **102** to complete the charging process.

FIG. **10** is a flow diagram **1000** illustrating a process including charging a rechargeable battery **106** of a computing device **102** using a charging port **404** having a locking mechanism **408**. The process of the flow diagram **1000** is illustrative and non-limiting, and other processes including one or more other steps, omitting one or more of the depicted steps, or proceeding in other orders of execution, may also be used.

Block **1002** connects a computing device **102** to a charging port **404**. For purposes of a present example, the user **104** approaches the self-service secure charging station **402**. The user **104** determines through visual inspection that the charging port **404**(**3**) is available for use. The user **104** connects the computing device to an electrical connector, docking feature, or other aspect of the charging port **404**(**3**). In another instance, the user **104** lays the computing device

102 upon an inductive-type charging pad of the charging port 404(3). Other coupling or connecting schemes may also be used. The result is that the computing device 102 is now in electrical communication with the charging port 404(3).

Block 1004 receives a payment for use of the charging port 404(3). In the present example, the user 104 then communicates with the server 112 by way of a user interface 302 presented by the computing device 102. The user provides credit card information to the server 112, and indicates that twenty-five minutes of charging time are required. The server 112 then communicates a verification of the payment back to the user device 102, as well as verifying that charging port 404(3) is to be used. In another instance, the server 112 may use a computing device 102 identification number, serial number, user 104 club membership code, or other identifier so as to verify an access privilege of the user 104 with respect to the corresponding charging station 122. Such identification information may also facilitate payment by later billing, account charge, or other mechanism, in lieu of payment by credit card at the present time.

Block 1006 locks, using a pager key 410, a locking mechanism 408 of the charging port 404 and removes the pager key 410. In the present example, the user 104 closes a metallic cage or cover over the computing device 102 such that a locking mechanism 408(3) engages. The user 104 then removes a pager key 410 from a connector or the locking mechanism 408(3) of the charging port 404(3). The charging port 404(3) is now in a secured state, such that the computing device 102 is protected against "walk-away" theft by an adverse party. The user 104 may now depart from the SSSCS 402 with confidence that the computing device 102 is locked in place.

Block 1008 provides charging current to a battery 106 of the computing device 102. In the present example, electrical current is communicated through the charging port 404(3) to the computing device 102 such that a rechargeable battery 106 begins to charge from a lesser energy storage level to a greater energy storage level. The server 112 or other control system of the SSSCS 402 is programmed to provide such charging current for twenty-five minutes as purchased by the user 104.

Block 1010 downloads a digital content 406 file to storage 714 of the computing device 102. In the present example, the server 112 communicates advertising regarding services or items available from the SSSCS 402, or other charging stations 402 or 412 operated as part of a commercial enterprise, to the computing device 102. Such advertising is provided as digital content 406 that is stored within non-transitory storage media 714 of the computing device 102. The advertising may be configured to present information on the display 708 of the computing device based on present geographic location, in accordance with a present level of the rechargeable battery 106, and so forth.

Block 1012 receives, using the pager key 410, a wireless paging signal indicating that a charging of the computing device 102 is complete. In the present example, the pager key 410 receives a wireless signal 110 indicating that the twenty-five minute charging process of the computing device 102 is complete. The pager key 410 then provides an audible or visible indication, or both, to that effect. The user 104 is now aware that charging of the rechargeable battery 106 of the computing device 102 is done.

Block 1014 unlocks, using the pager key 410, the locking mechanism 408(3) and retrieves the computing device 102. In the present example, the user 104 returns to the location of the SSSCS 402 and returns the pager key 410 to its connector or receiving point on the locking mechanism 408(3) of the charging port 404(3). In response, the locking mechanism 408(3) unlocks and the metallic cage or cover may be opened, such that the computing device 102 may be removed. The user 104 retrieves the computing device 102, and departs from the SSSCS 402.

FIG. 11 is a flow diagram 1100 illustrating a process including presenting information regarding a battery charge level and an estimated charging time. The process of the flow diagram 1100 is illustrative and non-limiting, and other processes including one or more other steps, omitting one or more of the depicted steps, or proceeding in other orders of execution, may also be used.

Block 1102 measures a present battery 106 level within a computing device 102. For purposes of a present example, the finder module 108 measures a present level of 22% for the rechargeable battery 106, which provides operating energy to the computing device 102. In one instance, the finder module 108 uses electronic circuitry or other resources to measure the rechargeable battery 106 level. In another instance, the finder module 108 receives information or data corresponding to the rechargeable battery 106 level from power management resources or other aspects of the computing device 102.

Block 1104 accesses one or more power profiles 510 corresponding to the computing device 102. In the present example, the finder module 108 accesses power profiles 510 within the computing device 102 corresponding to two respective operations that the user 104 is expected to perform. For instance, power profiles 510 describing power consumption for two hours of movie viewing and forty-five minutes of handling e-mail messages are selected. The finder module 108 further determines that 4 hours of operation have already elapsed for the present day, with an estimated remaining operating period of 2.75 hours.

Block 1106 estimates a battery level requirement based on the present battery level and the power profiles 510. In the present example, the finder module 108 uses the power profiles 510 to further estimate that a rechargeable battery 106 level of 65% is likely required to provide sufficient power the remaining operating hours expectation of 2.75 hours. Thus, an estimated battery 106 level shortfall exists of (65%−22%)=43%. That is, the finder module 108 estimates that the rechargeable battery 106 must be charged so as to add 43% to the present level of 22%.

Block 1108 estimates a time to recharge the battery 106 to the needed battery level. In the present example, the finder module 108 uses the power profiles 510 once again to estimate that a charging time of thirty-seven minutes is likely required to add the estimated 43% of level to the rechargeable battery 106.

Block 1110 presents information regarding the battery level and charging time values and estimates. In the present example, the finder module 108 causes a user interface 302 to appear on the display 708 of the computing device 102. The user interface 302 may include a battery display 306, including a battery graph 308 or other indicia of the present battery level of 22%, and the estimated required battery level of 65%. The user interface 302 may also include time estimates 310, indicative of the thirty-seven minutes of charging time estimated to raise the recharge battery 106 to the 65% level. The user 104 is now aware of the need to recharge the computing device 102 in order to continue operating through the remainder of the estimated workday.

FIG. 12 is a flow diagram 1200 illustrating a process including charging two different load devices using an accessory device. The process of the flow diagram 1200 is illustrative and non-limiting, and other processes including

one or more other steps, omitting one or more of the depicted steps, or proceeding in other orders of execution, may also be used.

Block **1202** connects an accessory device **502** to a charging port **404**. For purposes of a present example, the user **104** couples the accessory device **502** to a charging port **404**. The connection may be made using a USB-protocol cable and connector, or by way of another suitable cabling or connection arrangement. The accessory device **502** is now in electrical communication with the charging port **404**.

Block **1204** begins charging the battery or batteries **106** of the accessory device **502**. In the present example, charging power **512** is provided from the charging port **404** to the accessory device **502**. In turn, the operating module **504** functions to regulate or control the charging of the battery(s) **106** using the charging power **512**.

Block **1206** connects a first and a second load device **508** to the accessory device **502**. In the present example, the user **104** connects the computing device **102** and the smart phone **422** to the accessory device **502**, wherein the computing device **102** and the smart phone **422** define first and second load devices **508**, respectively. USB or other cabling or connector types may be used to make the respective connections. Thus, the computing device **102** and the smart phone **422** are connected in electrical communication with the accessory device **502**.

Block **1208** acquires respective charging parameters from the first and second load devices **508**. In the present example, the accessory device **502** receives charging parameter information, such as voltage and current values, from the management module **518** of the computing device **102**, by way of the power and data **514** signaling. The smart phone **422** communicates charging parameters to the management module **518** by way of the wireless signals **110**, and the computing device **102** then relays these parameters to the accessory device **502** by way of the power and data **514** signaling. The operating module **504** receives these respective charging parameters, accordingly. The wireless signals **110** may be in accordance with Wi-Fi™, Bluetooth®, or another suitable protocol.

Block **1210** provides charging currents to the first and second load devices **508** in accordance with the parameters. In the present example, the accessory device **502** provides electrical energy to the computing device **102** by way of the power and data **514** signaling, and the battery **106** of the computing device **102** begins to charge. In turn, the accessory device **502** provides electrical energy to the smart phone **422** by way of the power **516** signaling, and a battery **106** or energy storage device of the smart phone **422** begins to charge, accordingly. The operating module **504** may control voltage or current characteristics, or both, of the two respective electrical energy feeds to the computing device **102** and the smart phone **422**. Alternatively, resources of the computing device **102** or the smart phone **422**, respectively, may regulate or limit such charging actions.

Block **1212** acquires respective battery **106** levels from the accessory device **502** and the first and second load devices **508**. In the present example, the management module **518** queries the accessory device **502** for a present level value of its battery **106**, using the power and data **514** signaling. The computing device **102** also queries the smart phone **422** for a present battery **106** level value, using the wireless signals **110**. The accessory device **502** and the smart phone **422** communicate their respective battery **106** levels to the management module **518**. The management module **518** also acquires a present level of the battery **106** of the computing device **102** from circuitry or resources internal thereto.

Block **1214** estimates respective operating times for the first and second load devices **508**. In the present example, the management module **518** estimates operating or "run" times for the computing device **102** and the smart phone **422**, respectively, based on the respective battery **106** levels of these load devices **508** and the accessory device **502**. Specifically, the management module **518** historic usage data **506** or one or more power profiles **510**, or both, to estimate or predict energy consumption quantities for the computing device **102** and the smart phone **422**, respectively.

Such energy consumption estimates may then be used, along with the respective present battery **106** levels, to estimate operating times for the computing device **102**. Such estimates may be in terms of minutes, hours and minutes, seconds, or other suitable units. The result is that the management module **518** estimates how long the computing device **102** and the smart phone **422**, respectively, may be used by way of energy stored within their internal batteries **106**, and by way of the energy stored within the accessory device **502**. Estimated total operating times for the computing device **102** and the smart phone **422** may also be determined, wherein a particular total operating time is based on stored energy of the particular load device **508** plus stored energy of the accessory device **502**. Thus, an estimated total operating time is based, in part, on energy that may be transferred from the accessory device **502** to a particular load device **508**.

Block **1216** presents, using one of the load devices **508**, information based on the battery **106** levels and the operating times. In the present example, the management module **518** of the computing device **102** presents displayed data **124** using a display **708**. The displayed data **124** may include the battery **106** levels of the accessory device **502**, the computing device **102**, or the smart phone **422**, or any combination of or all of these. The displayed data **124** may also include the respective estimated operating times, which may be presented in minutes, hours and minutes, and so on. Other varying or related information may also be presented. In this way, the user **104** is apprised of the likely operating times for the computing device **102** and the smart phone **422**, respectively, prior to or during business travel, at the onset of a workday or other meaningful time period, and so forth. Task management, anticipation of recharging periods, and other planning may be performed by the user **104** in view of the information provided by the displayed data **124**.

As described above, estimates regarding levels of rechargeable battery or other energy storage devices within computing devices or other equipment may be determined and presented to a user. Estimated charging times for such batteries or energy storage devices may also be presented. Stored information, or information available through a wireless network, may be accessed and used to identify or locate charging stations provided within accessible venues, which may be open to the public or to the particular user, that are near to the present location of the computing device. A user may then select a suitable venue for recharging the battery or batteries within their computing device based on the presented information. Additionally, a reservation for such a charging station may be made, or items or services may be ordered in advance of arriving at a corresponding, selected venue.

Those having ordinary skill in the art will readily recognize that certain steps or operations illustrated in the figures

above can be eliminated or taken in an alternate order. Moreover, the methods described above may be implemented as one or more software programs for a computer system and are encoded in a computer readable storage medium as instructions executable on one or more processors.

Embodiments may be provided as a computer program product including a non-transitory computer readable storage medium having stored thereon instructions (in compressed or uncompressed form) that may be used to program a computer (or other electronic device) to perform processes or methods described herein. The computer readable storage medium can be any one of an electronic storage medium, a magnetic storage medium, an optical storage medium, a quantum storage medium and so forth. For example, the computer readable storage media may include, but is not limited to, hard drives, floppy diskettes, optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, flash memory, magnetic or optical cards, solid-state memory devices, or other types of physical media suitable for storing electronic instructions. Further, embodiments may also be provided as a computer program product including a transitory machine-readable signal (in compressed or uncompressed form). Examples of machine-readable signals, whether modulated using a carrier or not, include, but are not limited to, signals that a computer system or machine hosting or running a computer program can be configured to access, including signals transferred by one or more networks. For example, the transitory machine-readable signal may comprise transmission of software by the Internet.

Separate instances of these programs can be executed on or distributed across separate computer systems. Thus, although certain steps have been described as being performed by certain devices, software programs, processes, or entities, this need not be the case and a variety of alternative implementations will be understood by those having ordinary skill in the art.

Additionally, those having ordinary skill in the art readily recognize that the techniques described above can be utilized in a variety of devices, environments and situations. Although the present disclosure is written with respect to specific embodiments and implementations, various changes and modifications may be suggested to one skilled in the art and it is intended that the present disclosure encompass such changes and modifications that fall within the scope of the appended claims.

What is claimed is:

1. A computing device, configured to:

determine, using electronic circuitry of the computing device, a present level of energy stored by a rechargeable battery, wherein the rechargeable battery is configured to provide operating power to the computing device;

estimate, using a processor of the computing device and based on historical usage data stored within a memory, a greater stored energy level of the rechargeable battery to operate the computing device for a period of time;

estimate, using the processor of the computing device and based on the present stored energy level of the rechargeable battery, a time to charge the rechargeable battery to the greater stored energy level;

provide a request to a server to access charging station information indicative of locations of one or more charging stations, wherein at least a subset of the locations correspond to one or more venues accessible to a user of the computing device;

receive at least a portion of the charging station information from the server;

present, using a display associated with the computing device, the locations of at least a subset of the one or more charging stations, the present stored energy level of the rechargeable battery, the greater stored energy level of the rechargeable battery, and the time to charge the rechargeable battery to the greater stored energy level.

2. The computing device of claim **1**, further configured to:

send, using a communications interface of the computing device, a request to reserve a charging port at a charging station of the one or more charging stations;

receive a response to the request, the response including an acceptance of the request; and

present, using the display associated with the computing device, the response, wherein the presentation is indicative of the acceptance of the request.

3. The computing device of claim **1**, further configured to discontinue operation of one or more communication nodes of the computing device while the computing device is electrically connected to a charging port of the one or more charging ports.

4. The computing device of claim **1**, further configured to:

receive user input indicative of a selection of a charging station of the one or more charging stations; and

present output associated with one or more of:

a map associated with a location of the charging station;

navigational aid associated with the location of the charging station;

reservation information associated with the charging station; or

one or more items or services offered by an entity associated with the charging station.

5. The computing device of claim **1**, further configured to:

access calendar data associated with the computing device, the calendar data indicating a time that a user of the computing device is available to charge the computing device;

wherein the request to access the charging station information is provided based at least in part on correspondence between the time that the user of the computing device is available and the time to charge the rechargeable battery to the greater stored energy level.

6. A method performed at least in part by a hardware processor, the method comprising:

providing, to a first device, a request to access information regarding a charging station within a distance of a computing device, the computing device including an energy storage device, wherein the charging station is separate from the first device;

receiving at least a portion of the information regarding the charging station from the first device;

estimating a time to charge the energy storage device from a present energy level to a greater energy level, wherein the greater energy level corresponds to an estimated energy consumption of the computing device; and

presenting, by way of a presentation device associated with the computing device, the present energy level, the time to charge the energy storage device, and the at least a portion of the information regarding the charging station.

7. The method of claim **6**, further comprising:

estimating a future power consumption from the energy storage device corresponding to a time period; and

determining, based on the present energy level and the estimated future power consumption, the greater energy level.

8. The method of claim **6**, further comprising:

accessing calendar data stored within the computing device, wherein the calendar data indicates one or more of: a time that a user of the computing device is available to charge the computing device; or a time that the user of the computing device is not available to charge the computing device; and

providing the calendar data to the first device;

wherein the request to access the information regarding the charging station is provided based at least in part on correspondence between the calendar data and the time to charge the energy storage device from the present energy level to the greater energy level.

9. The method of claim **6**, further comprising:

receiving, from an entity associated with the charging station, an indication of one or more of an item or a service offered by the entity; and

sending, from the computing device to the entity, an order regarding the one or more of the item or the service.

10. The method of claim **6**, further comprising;

presenting information regarding at least two charging stations;

receiving user input selecting the charging station; and

sending, from the computing device to an entity associated with the charging station, a request to reserve a port for use by the computing device.

11. The method of claim **6**, further comprising:

coupling the computing device to a port of the charging station, wherein the port is configured to provide a fuel cell reactant to the energy storage device; and

securing, using a locking mechanism, the computing device to the charging station.

12. The method of claim **11**, wherein the locking mechanism is operated using an electronic pager device configured to indicate, as received by way of wireless signals, a charging status of the energy storage device of the computing device.

13. The method of claim **6**, further comprising:

connecting the computing device to a port of the charging station;

providing, using the port, electrical energy to the energy storage device; and

providing, using the port, digital content to the computing device, wherein the digital content includes one or more of an audio file, a video file, an e-book, an advertisement, an application, an operating system, or an upgrade.

14. The method of claim **6**, wherein the information includes at least one of:

a map associated with a location of the charging station;

a distance from the computing device to the charging station;

navigational aid associated with the location of the charging station; or

reservation information associated with the charging station.

15. The method of claim **6**, further comprising sending, from the computing device to an entity associated with the charging station, a request to reserve a charged battery in accordance with a battery exchange program.

16. One or more non-transitory computer readable storage media including program code, the program code configured to cause one or more processors to:

retrieve information stored within a non-transitory storage medium, information including one or more of a user-established setting or a data file of a first computing device;

provide the information to a memory of a second computing device;

determine a present level of an energy storage device of the second computing device;

estimate, using one or more of historical usage data or a power profile, an estimated level for the energy storage device, the estimated level corresponding to a future energy requirement for the second computing device;

access charging station information from one or more of the first computing device, the second computing device, or a third computing device in communication with the second computing device, the charging station information indicating one or more charging stations accessible to the energy storage device, wherein the one or more charging stations are separate from the one or more of the first computing device, the second computing device, or the third computing device; and

present, using an output device, at least a subset of the charging station information and information regarding one or more of the present level or the estimated level.

17. The one or more non-transitory computer readable storage media of claim **16**, the program code further configured to cause the one or more processors to send a message to an entity associated with a charging station of the one or more charging stations, wherein the message includes at least one of a request to reserve a charging port, an order for an item, or an order for a service.

18. The one or more non-transitory computer readable storage media of claim **17**, the program code further configured to cause the one or more processors to send status information regarding a charging of the energy storage device to a remote computing device by way of wireless signals, wherein the second computing device stores contact information for the remote computing device, and wherein the remote computing device is configured to provide an indication corresponding to the status information.

19. The one or more non-transitory computer readable storage media of claim **16**, the program code further configured to cause the one or more processors to send an alert to a remote computing device, wherein the alert indicates that one or more of the first computing device or the second computing device has been reported stolen.

20. The one or more non-transitory computer readable storage media of claim **16**, wherein the data file includes calendar data indicating a time that a user of the energy storage device is available to charge the energy storage device, the program code further configured to cause the one or more processors to:

determine a time to charge the energy storage device to the estimated level; and

present the at least a subset of the charging station information calendar data based on correspondence between the time that the user of the energy storage device is available and the time to charge the energy storage device to the estimated level.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,442,548 B1
APPLICATION NO. : 14/218938
DATED : September 13, 2016
INVENTOR(S) : Jesper Mikael Johansson et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page of Patent: column 2, line 7, (56) References Cited, U.S. Patent Documents, 2013/0311803 A1* 1/2013 Abendroth ... G06F 1/3212 713/320

Correction: 2013/0311803 A1* 11/2013 Wang ... G06F 1/3212 713/320

Signed and Sealed this
Fifteenth Day of November, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office